# Zur Geschichte der Kleidung in der Steinzeit

# A Stone Age history of clothing

17. Mitteldeutscher Archäologentag
vom 26. bis 28. September 2024 in Halle (Saale)

**Herausgeber Olaf Jöris, Oliver Dietrich, Roberto Risch und Harald Meller**

33 2025 TAGUNGEN DES LANDESMUSEUMS FÜR VORGESCHICHTE HALLE

Tagungen des
Landesmuseums für Vorgeschichte Halle
**Band 33 | 2025**

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Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt
LANDESMUSEUM FÜR VORGESCHICHTE

herausgegeben von
Olaf Jöris,
Oliver Dietrich,
Roberto Risch
und Harald Meller

Halle (Saale)
2025

Bibliografische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://portal.dnb.de abrufbar.

ISBN 978-3-948618-99-5 e-ISBN 978-3-96929-468-0
ISSN 1867-4402 e-ISSN 2942-6685

*Redaktion* Florian Michel, Manuela Schwarz, Britta Stein, Rocco Steputat • LDA

*Lektorat der englischen Texte und Übersetzung ins Englische bzw. Deutsche* Carola Murray-Seegert • Oberursel

*Organisation und Korrespondenz* Aniela Schuchardt, Manuela Schwarz • LDA
*Technische Bearbeitung* Anne Gottstein, Birte Janzen, Brigitte Parsche • LDA

*Vor- und Nachsatz* Gestaltung Birte Janzen • LDA; © M. Lagarde, 2020

*Sektionstrenner* Gestaltung Birte Janzen • LDA

*Umschlag* Gestaltung Brigitte Parsche • LDA, nach Karol Schauer • Salzburg

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*Printversion* Publiziert bei Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Richard-Wagner-Str. 9, 06114 Halle (Saale); https://www.lda-lsa.de

Propylaeum
FACHINFORMATIONSDIENST ALTERTUMSWISSENSCHAFTEN

*Online-Ausgabe* Publiziert bei
Universität Heidelberg/Universitätsbibliothek, 2026
Propylaeum – Fachinformationsdienst Altertumswissenschaften
Grabengasse 1, 69117 Heidelberg
https://www.uni-heidelberg.de/de/impressum
E-Mail: ub@ub.uni-heidelberg.de

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*URN* urn:nbn:de:bsz:16-propylaeum-ebook-1678
*DOI* https://doi.org/10.11588/propylaeum.1678

*Papier* alterungsbeständig nach DIN/ISO 9706
*Satzschrift* FF Celeste Pro, News Gothic

*Konzept und Gestaltung* Carolyn Steinbeck • Berlin
*Layout, Satz und Produktion* Anne Gottstein, Birte Janzen, Brigitte Parsche • LDA

*Druck und Bindung* MUNDSCHENK Druck + Medien, Lutherstadt Wittenberg

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# Zur Geschichte der Kleidung in der Steinzeit – eine Einführung/ *A Stone Age history of clothing – an introduction*

Olaf Jöris, Oliver Dietrich, Harald Meller und Roberto Risch

Der 17. Mitteldeutsche Archäologentag widmete sich dem Thema »A Stone Age history of clothing« (»Zur Geschichte der Kleidung in der Steinzeit«). Kleidung ist in der Archäologie ein viel diskutiertes Thema, was nicht zuletzt auf ihre Rolle bei der Konstruktion und dem Ausdruck sozialer Identität zurückzuführen ist[1]. Während zu früher Kleidung bereits viel geforscht wurde, konzentrieren sich umfassende Arbeiten vor allem auf die Jungsteinzeit und die spätere Vorgeschichte[2], was zum Teil auf das reichhaltigere Quellenmaterial und die bessere Erhaltung von Kleidungsstücken zurückzuführen ist, die eine solidere Grundlage für detaillierte Rekonstruktionen von Bekleidung und Herstellungstechniken bieten. Die Tagung und die vorliegende Publikation geben erstmals einen Überblick über die verschiedenen Forschungsstränge zur frühesten Geschichte der Kleidung in der Steinzeit. Die Themen der hier vorgestellten Beiträge sind entsprechend breit gefächert. Das Thema wurde interdisziplinär in rund 40 Vorträgen behandelt, die von jungen Forschern sowie führenden Autoritäten ihrer wissenschaftlichen Fachgebiete gehalten wurden, die aus 16 verschiedenen Ländern der Welt vom 26. bis 28. September 2024 zu einer inspirierenden wissenschaftlichen Konferenz in Halle (Saale) zusammenkamen. Das große Publikum mit mehr als 100 Gästen belegte das breite Interesse an diesem Thema, das einen der zentralen Aspekte der menschlichen Kultur darstellt und unser tägliches Leben noch immer prägt und maßgeblich beeinflusst (Abb. 1).

Die Konferenz wurde gemeinsam vom Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt (LDA) in enger Zusammenarbeit mit der Martin-Luther-Universität Halle-Wittenberg, dem in Neuwied gelegenen MONREPOS Archäologischen Forschungszentrum und Museum für Menschliche Verhaltensevolution des Leibniz-Zentrums für Archäologie (LEIZA) in Mainz und der Abteilung für Vorgeschichte der Universität Autònoma de Barcelona (UAB) in Spanien organisiert. Im Rahmen eines Empfangs und während Führungen hatten die Konferenzteilnehmer die Möglichkeit, das ebenfalls in Halle gelegene Landesmuseum für Vorgeschichte zu besuchen.

Eine wichtige und zentrale Installation, die die Besucher in einem der ersten, der Altsteinzeit gewidmeten Räume des Landesmuseums empfängt, ist die Rekonstruktion eines »archaischen« Vertreters der Gattung *Homo* von É. Daynès:

The 17th Archaeological Conference of Central Germany was dedicated to »A Stone Age history of clothing«. Clothing has been a much-discussed topic in archaeology, owing in part to its role in the expression of social identities[1]. While much research has been done on early clothing, comprehensive works have focused mostly on the Neolithic and later prehistory[2], due in part to the richer source material and better preservation of actual clothing items that provide a superior base for detailed reconstructions of attire and manufacturing techniques. The conference and the present publication, for the first time, target an overview of the different strands of research on the earliest history of clothing in the Stone Age. The topics of the papers presented here are accordingly broad. The topic was covered interdisciplinarily through some 40 presentations, given by young researchers as well as leading authorities in their scientific fields that came from 16 different countries around the world to assemble in Halle (Saale), Germany, from the 26th to the 28th of September 2024 for an inspiring scientific conference. The large audience of more than 100 guests documented the wide interest into this topic, which represents one of the key aspects of human culture, still shaping and significantly influencing our daily lives (Fig. 1).

The conference was organised jointly by the State Office for Heritage Management and Archaeology Saxony-Anhalt (LDA) in close cooperation with the Martin Luther University Halle-Wittenberg, the Neuwied-based MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution of the Leibniz-Zentrum für Archäologie (LEIZA) in Mainz, and the Department of Prehistory at the Universitat Autònoma de Barcelona (UAB) in Spain. During a reception and guided tours, conference participants had the opportunity to visit the State Museum of Prehistory, also located in Halle.

An important and central installation welcoming the visitors to one of the State Museum's first rooms dedicated to the Palaeolithic is the reconstruction of an archaic representative of the genus *Homo* made by É. Daynès: a male displayed in seated position whom museum visitors meet at eye level (Fig. 2). With his right elbow resting on his left leg, the open fist supports his chin. In this position, the reconstruction closely resembles the famous »Thinker« sculptures made by the French artist A. Rodin. That museum

1 Z. B. Roach-Higgins u. a. 1995; Sørensen 1997; Eicher/Evenson 2015; Grömer/Neugebauer-Maresch 2017.
2 Z. B. Barber 1991; Gleba/Mannering 2012; Grömer 2016; Siennicka u. a. 2018.

1 E.g. Roach-Higgins et al. 1995; Sørensen 1997; Eicher/Evenson 2015; Grömer/Neugebauer-Maresch 2017.
2 E.g. Barber 1991; Gleba/Mannering 2012; Grömer 2016; Siennicka et al. 2018.

**Abb. 1** Teilnehmerinnen und Teilnehmer des 17. Mitteldeutschen Archäologentages in Halle (Saale). Von links unten nach rechts:

***Fig. 1*** *Participants in the 17th Archaeological Conference of Central Germany in Halle (Saale). From bottom left to right:*

Roberto Risch, Kayleigh Saunderson, Karina Grömer, Thomas Junker, Harald Meller, Tuija Kirkinen, Liliana Janik, Cristina de Guzman Strong, Shumon T. Hussain; Martha Görlitz, Lukas Dobler, Kelvin Wilson, Albert Hafner, Kristiina Mannermaa, Peter Vang Petersen, Andrew Kandel; Francisco Martínez-Sevilla, Anabel Ortiz, María Isabel Borao Álvarez, Pauline Coste, Sonja Tomasso, Veerle Rots, Christina Marangou, Sybille Wolf, Olaf Jöris, Susanne Friederich; Marian Vanhaeren, Wulf Schiefenhövel, Mark Collard, Susanna Harris, Jörg Orschiedt; Joshua London, Thorsten Uthmeier, Ulla Mannering, Oliver Dietrich, João Zilhão, Andrew Kitchen, Ivo Verheijen.
Nicht auf dem Bild/Not shown: Simon Kaner, João Marreiros, Nicholas J. Conard, Dries Cnuts, Giacomo Giacobini, Riitta Rainio, Annelou van Gijn.

ein Mann in sitzender Position, dem die Museumsbesucher auf Augenhöhe begegnen (Abb. 2). Mit dem rechten Ellbogen auf dem linken Bein ruhend, stützt die offene Faust sein Kinn. In dieser Haltung ähnelt die Rekonstruktion stark den berühmten »Denker«-Skulpturen des französischen Künstlers A. Rodin. Dass die Museumsbesucher diesem Zeitgenossen auf Augenhöhe begegnen und ihn sofort mit dem »Denker« in Verbindung bringen, ist Teil des didaktischen Konzepts der Ausstellung: Die Menschen erhalten automatisch einen Einblick in die geistigen Fähigkeiten dieser archaischen Menschen (Meller 2003) und blicken nicht auf einen »primitiven« Vorfahren herab. Obwohl das Museumskonzept darauf abzielt, Vorurteile über unsere menschliche Vergangenheit, die viele Menschen noch immer haben, abzubauen, wird der Neandertaler nackt gezeigt: Das liegt einfach daran, dass wir nicht sicher wissen, ob diese archaischen Menschen bekleidet waren oder nicht.

Dass wir oft nicht wissen, ob und wie Menschen in der Steinzeit, insbesondere in der Altsteinzeit, gekleidet waren, liegt vor allem an den schlechten Erhaltungsbedingungen für die vergänglichen Materialien, aus denen Kleidung meist hergestellt wurde. Über lange Zeiträume hinweg waren die für die Erhaltung solcher Materialien erforderlichen Bedin-

visitors meet this fellow at eye level and immediately associate him with »The Thinker« is part of the exhibition's didactic concept: people automatically get a glimpse of the mental capabilities of these archaic humans (Meller 2003), and do not look down on a ›primitive‹ predecessor of ours. Although the museum concept aims to eliminate prejudices about our human past that many people still hold, the Neanderthal is shown naked: this is simply because we do not know for sure whether or not these archaic humans were dressed.

The reason we often do not know whether or how people in the Stone Age (particularly in the Palaeolithic period) were dressed stems mainly from the poor preservation conditions for the perishable materials from which clothes were typically made. Over long periods, the required conditions suitable for the preservation of such materials have rarely been met, and seldom have these conditions remained stable over millennia. As a result, the Stone Age record of clothes is extremely restricted. But in rare cases, in which waterlogged sediments or ice (e.g. contributions of Mario Mineo and colleagues and Albert Hafner in this volume) or extremely dry conditions (e.g. Maria Herrero-Otal and colleagues in this volume) have conserved clothes or other organic materials, finds may be

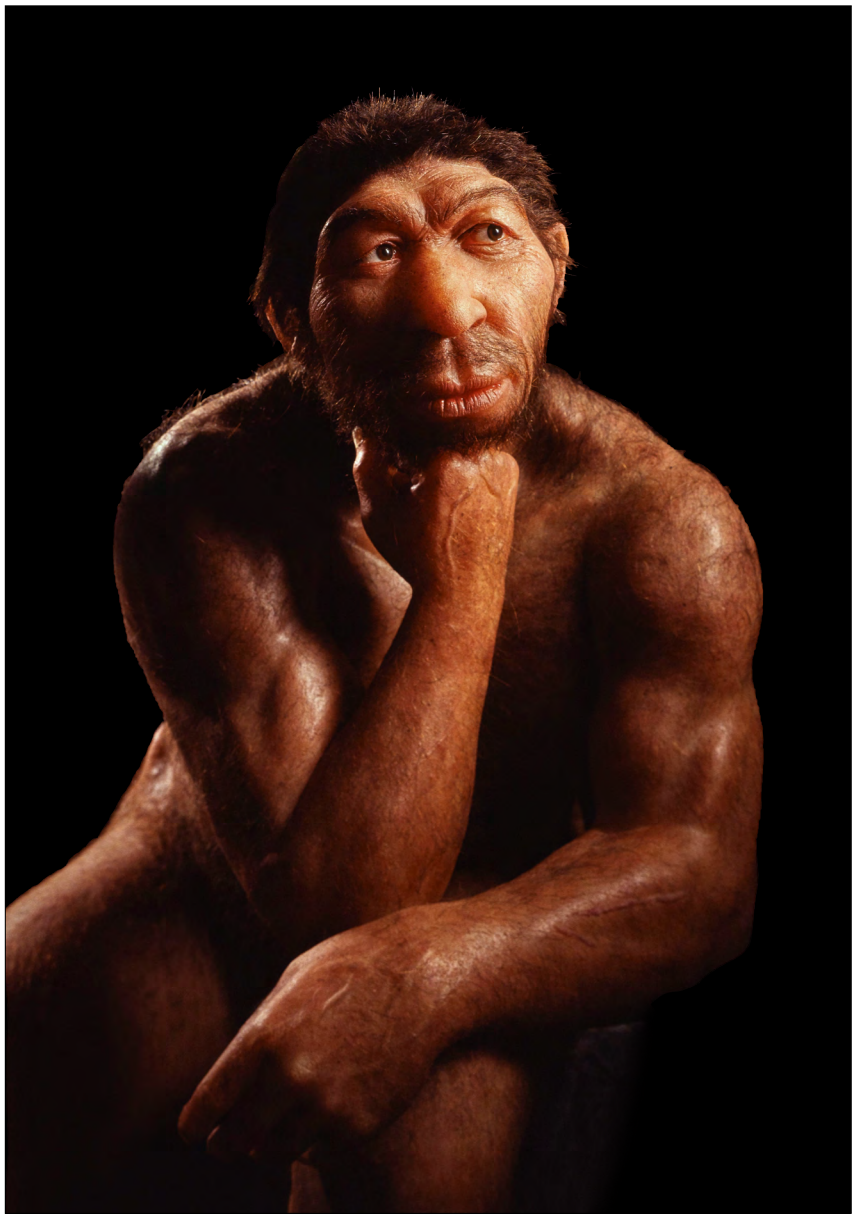

**Abb. 2** Ein spätarchaischer Vertreter der Gattung *Homo*, ausgestellt im Landesmuseum für Vorgeschichte in Halle (Saale). Rekonstruktion von E. Daynès, 2003, inspiriert von A. Rodins »Der Denker«.

***Fig. 2*** *A late archaic representative of the genus* Homo *on display at the State Museum for Prehistory in Halle (Saale). Reconstruction by E. Daynès, 2003, inspired by A. Rodin's »The Thinker«.*

gungen nur selten gegeben, und nur selten blieben diese Bedingungen über Jahrtausende hinweg stabil. Daher sind die Funde von Kleidung aus der Steinzeit äußerst begrenzt. In vereinzelten Fällen jedoch, in denen wassergesättigte Ablagerungen oder Eis (siehe Beiträge Mineo u. a. oder Hafner in diesem Band) oder extrem trockene Bedingungen (z. B. Beitrag Herrero-Otal u. a. in diesem Band) Kleidung oder andere organische Materialien konserviert haben, können Funde spektakuläre Erkenntnisse liefern und Aspekte des menschlichen Lebens und der Kultur in der Vergangenheit beleuchten, die unter den weitaus häufigeren ungünstigeren Überlieferungsbedingungen völlig im Dunkeln geblieben wären.

Im Gegensatz zu späteren Epochen, vor allem ab der Bronzezeit[3], und abgesehen von einigen wenigen früheren ikonischen, weltberühmten Funden, von denen die Gletschermumie »Ötzi« vom Tisenjoch in Italien sicherlich der

spectacular and illuminate aspects of past human lives and culture which – under the far more frequent less-favourable conditions – would otherwise remain entirely in the dark.

In contrast to later periods, mainly from the Bronze Age onwards[3], and excepting a few earlier iconic, world-famous finds, of which the »Ötzi« Iceman glacial mummy from the Tisenjoch in Italy is surely the best-known (Egg/Spindler 1992; Egg/Spindler 2009), not many clothes are preserved from Stone Age periods. Why, then, should we dedicate an international conference to research into Stone Age clothing? The answer is simple: the Stone Age is the lengthy period in which almost all essential materials used for clothing and their production were recognised as suitable and first exploited, from animal skins or pelts to leather and hides, and from plant fibres – including even cotton (Liu et al. 2022) – to textiles. Furthermore, almost all of the fundamental techniques employed to process the

3 Z. B. Barber 1991; Gleba/Mannering 2012; Grömer 2016; Siennicka u. a. 2018.

3 E.g. Barber 1991; Gleba/Mannering 2012; Grömer 2016; Siennicka et al. 2018.

bekannteste ist (Egg/Spindler 1992; Egg/Spindler 2009), sind aus der Steinzeit nicht viele Kleidungsstücke erhalten. Warum also sollten wir der Erforschung der Steinzeitkleidung eine internationale Konferenz widmen? Die Antwort ist einfach: Die Steinzeit ist die lange Zeit, in der fast alle für Kleidung und ihre Herstellung notwendigen Materialien erstmals als geeignet erkannt und genutzt wurden, von Tierhäuten oder Fellen über Leder und Häute bis hin zu Pflanzenfasern – darunter sogar Baumwolle (Liu u. a. 2022) – und Textilien. Darüber hinaus scheinen spätestens am Ende der Jungsteinzeit fast alle grundlegenden Techniken zur Verarbeitung der verschiedenen Materialien, die für die Herstellung von Kleidung verwendet wurden (mit Ausnahme von Klöppeln, Stricken und Häkeln), bekannt gewesen zu sein (vgl. Gilroy 1845 [2023]). Im Laufe der Zeit haben sich die meisten Techniken diversifiziert und technisch weiterentwickelt, beispielsweise im Bereich der Webtechniken (z. B. Broudy 1993), aber ihre Grundprinzipien blieben bis zum technologischen Aufschwung zu Beginn der Industrialisierung weitgehend unverändert (Holden 2014; Allen 2018). Das Gleiche gilt für die verwendeten Materialien: Erst mit dem starken Aufschwung der chemischen Industrie in der Zeit nach dem Zweiten Weltkrieg wurden durch die Herstellung synthetischer Polymerfasern völlig neue Materialien mit neuen Eigenschaften für die Herstellung von Kleidung verfügbar (Carr 1995; Mather u. a. 2023).

Da Kleidung aus der Steinzeit nur selten erhalten geblieben ist, befasst sich der vorliegende Band nicht nur mit den »harten«, physisch überlieferten archäologischen Belegen für Steinzeitkleidung, sondern auch mit den »weichen«, indirekten und manchmal impliziten Belegen, die beispielsweise aus Grabbeigaben, der Untersuchung von Schmuck oder ikonografischer Quellen oder der Integration von Daten gewonnen werden können, die mit verschiedenen analytischen Methoden der archäologischen Wissenschaften oder anderen Disziplinen erhoben wurden. Solche Quellen beleuchten die Geschichte der Kleidung aus Perspektiven, die weit über die materiellen archäologischen Zeugnisse hinausgehen.

Ohne den Anspruch zu erheben, die gesamte archäologische Überlieferung steinzeitlicher Bekleidung abzudecken, nähert sich dieser Band dem Thema aus verschiedenen Perspektiven und versucht, wichtige Forschungsansätze zu verbinden, die in sieben thematischen Blöcken (Sektion I–VII) vorgestellt werden, die jeweils aus einzelnen Beiträgen bestehen. Die Grenzziehungen zwischen den sieben Sektionen sind nicht absolut, da mehrere Beiträge zu mehr als einem der in den verschiedenen Teilen behandelten Schlüsselthemen beisteuern.

**Sektion I** – »Von der Fiktion zur Wissenschaft und zurück« – befasst sich mit dem komplexen Zusammenspiel von Rekonstruktionen steinzeitlicher Menschen und ihrer Wahrnehmung durch Wissenschaftler und die Öffentlichkeit. Fragen wie die, ob Neandertaler sich anders kleideten als moderne Menschen (z. B. Collard u. a. 2016) und in welcher Beziehung sie zu uns stehen, waren und sind weiterhin von zentraler Bedeutung für die Darstellung der Menschen der Steinzeit in Museen. Was am Anfang der Forschung als »freie« und manchmal »naive« Rekonstruktionen begann,

different materials used in the production of clothes (probably excluding lacing, knitting, and crocheting) seem to be known at the latest by the end of the Neolithic (cf. Gilroy 1845 [2023]). With time, most techniques have diversified and progressed technically, for example, when it comes to weaving technologies (e.g. Broudy 1993), but their main principles remain largely unchanged until the significant technological boost that came with the beginning of industrialisation (Holden 2014; Allen 2018). The same applies to the materials used: It was not until the major rise of the chemical industry in the early post-World-War-II period that entirely new materials with new properties became available for the production of clothes through the large-scale use of synthetic polymer fibres (Carr 1995; Mather et al. 2023).

As Stone Age clothes have rarely been preserved, the present volume will not only address the »hard«, physical archaeological evidence for Stone Age clothing, but also the »soft«, indirect and sometimes implicit evidence that can be extracted, for example, from burial features, through the study of personal ornaments and iconographic sources, or the integration of data obtained by a variety of analytical methods from different fields of the archaeological sciences or other disciplines. Such sources shed light on the history of clothing from perspectives far beyond the material archaeological evidence.

Without attempting to cover the complete archaeological record of Stone Age clothing, this volume approaches the topic from varied perspectives and tries to bridge major avenues of research that are presented in seven thematic blocks (Sections I–VII), each composed of individual contributions. The seven sections are not mutually exclusive, as several papers contribute to more than one of the key topics tackled in the different parts.

**Section I** – »From fiction to science and back to fiction« – deals with the complex interplay of reconstructions of Stone Age people and their modern perception by scientists and the public. Questions such as whether Neanderthals dressed differently from modern humans (e.g. Collard et al. 2016) and how they relate to us have been and continue to be central to how Stone Age people are presented in museums. What began as ›liberal‹ and sometimes ›naïve‹ reconstructions in the early history of research, often poorly supported by sound archaeological evidence but based on the reconstructor's imagination, has developed into serious science-based craftsmanship today. P. Coste reviews the record of reconstructions found in museums around the world, including the State Museum of Prehistory in Halle, and addresses how the design and the perception of these reconstructions have changed through time. Such reconstructions feed back into research and influence how scientists formulate their hypotheses, as well as affecting the wider public. K. Saunderson and colleagues demonstrate in this volume how producers of popular media balance ›historical‹ authenticity with consumer expectations that underpin the success of their products. This has significant implications for how stereotypical or diverse life in the Stone Age is imagined, as illustrated by their findings.

**Section II** is titled »Reasons why humans dress«. The intentions behind clothing may be multiple and complex.

oft kaum durch fundierte archäologische Beweise gestützt, sondern vielmehr auf der Vorstellungskraft der Rekonstrukteure basierend, hat sich heute zu einer ernsthaften, wissenschaftlich fundierten Handwerkskunst entwickelt. P. Coste gibt einen Überblick über die Rekonstruktionen in Museen weltweit, darunter auch die im Landesmuseum für Vorgeschichte in Halle, und untersucht, wie sich die Gestaltung und Wahrnehmung dieser Rekonstruktionen im Laufe der Zeit verändert haben. Solche Rekonstruktionen haben Rückwirkungen auf die Forschung, beeinflussen die Formulierung von Hypothesen durch Wissenschaftler und wirken auf die Wahrnehmung der Themen in der breiten Öffentlichkeit. K. Saunderson und ihre Kollegen zeigen in diesem Band, wie Produzenten populärer Medien »historische« Authentizität mit den Erwartungen der Verbraucher in Einklang bringen, um damit für den Erfolg ihrer Produkte zu sorgen. Dies hat erhebliche Auswirkungen darauf, wie stereotyp oder vielfältig das Leben in der Steinzeit dargestellt wird.

**Sektion II** trägt den Titel »Gründe, warum sich Menschen kleiden«. Die Absichten hinter Kleidung können vielfältig und komplex sein. Entsprechend werden hier nicht die eindeutigen Gründe, warum Menschen Kleidung tragen herausgestellt, sondern vielmehr eine Vielzahl teilweise widersprüchlicher Erklärungsansätze untersucht. Das »Standardnarrativ« dafür, warum Menschen Kleidung tragen, folgt dem vereinfachenden Argument, dass Kleidung ursprünglich als Anpassung an klimatische und ökologische Herausforderungen entstanden sei, um die thermoregulatorischen und energetischen Anforderungen des menschlichen Körpers zu erfüllen (Gilligan 2010). Nach ihrer Erfindung setzte dann ein Prozess der zunehmenden »Kulturalisierung des menschlichen Körpers« ein – mit wachsendem Einfluss auf die Entwicklung des modernen menschlichen Sozialverhaltens (d'Errico 2024). In diesem Band befasst sich Ian Gilligan mit den Fragen, wann und vor allem warum Kleidung »von einer thermischen zu einer sozialen Notwendigkeit wurde« (vgl. Gilligan u. a. 2024; Übersetzung Verf.). Reduktionistische, funktionale (und verwandte) Sichtweisen auf die Natur der Kleidung, die meist den Erzählbogen von »einfach« und »primitiv« bis »komplex« und »ausgefallen« spannen, werden in dem Beitrag von S. T. Hussain kritisiert, der von einer Untersuchung der paläolithischen Mensch-Tier-Beziehungen ausgeht. Er führt eine ontologische Perspektive auf Kleidung ein, indem er betont, dass Kleidungsstücke, die häufig aus tierischen Materialien hergestellt werden, eine wichtige Rolle bei der Aushandlung von Mensch-Tier-Beziehungen in Gesellschaften spielen, deren Wirtschaftsweisen auf dem Jagen und Sammeln basieren. »Westliche Natur-Kultur-Binaritäten« existieren in solchen Gesellschaften nicht, und die Grenzen zwischen Tieren und Menschen sind oft durchlässig. Kleidung wird häufig als »lebendig und lebenswichtig« und als Ausdruck von Perspektivwechseln sowie eines »Tierwerdens« wahrgenommen. S. T. Hussain schlägt daher vor, paläolithische Kleidung als eine Form der »Zoomorphisierung des menschlichen Körpers« zu betrachten. Eine solche Perspektive würde alternative Bezugssysteme ermöglichen, die die »Kleidungskultur« »zivilisierter Menschen« nicht in Opposition zu einer »primitiven, nicht-menschlichen,

The question addressed here is thus not aimed at the definite reasons why humans dress, but explores, instead, a variety of partly contradictory approaches. The ›standard narrative‹ explaining why humans dress follows the simplifying argument that clothing initially evolved as an adaptation to climatic and environmental challenges, which needed to be compensated for in order to fulfil the thermoregulatory and energetic demands of the human body (Gilligan 2010). Once invented, clothing would then have triggered a process described as the »culturalisation of the human body« – with growing impact on the evolution of modern human sociality (d'Errico 2024). In this volume, Ian Gilligan addresses the questions of when and – above all – why clothing »transitioned from a thermal to a social necessity« (cf. Gilligan et al. 2024). Reductionist, functional (and related) views on the nature of clothing, which mostly span the narrative arc from ›simple‹ and ›primitive‹ to ›complex‹ and ›fancy‹, are criticised in the contribution by S. T. Hussain, starting from an examination of Palaeolithic human-animal relations. He introduces an ontological perspective on clothing by stressing that garments frequently made from animal materials play an important role in negotiating human-animal relations in societies based on hunting and gathering as a subsistence strategy. »Western nature-culture binaries« do not exist in such societies, and borders between animals and humans are permeable. Clothing is often perceived as being »frequently vital« and as a mode and expression of »becoming« an animal. S. T. Hussain consequently proposes to see Palaeolithic clothing as a way of »zoomorphising the human body«. Such a perspective would allow for alternative frames of reference that do not place the ›culture of clothing‹ of ›civilised humans‹ in opposition to ›primitive, non-human, wild nature‹[4]. But are these implicit dichotomous perspectives truly mutually exclusive? An intermediary perspective would interpret human culture as an integral part of human nature. From an Indigenous, but also from a Western perspective, where human thought and action often seem far more detached from the natural environment than in an indigenous perspective, clothing can be seen as an expression of a search for meaning. In different societies, the various concepts of what gives meaning will differ, but all of them serve the basic need to create individual and group identities and to define an individual's and the group's place within distinct overarching world concepts, thus producing meaning (e.g. Crawford/Rossiter 2006; Negru-Subțirică et al. 2016). All societies today seem to offer stages for multiple forms of (public) display and transmission of messages that create and shape identities, with clothing and style of dress being among the key ingredients of such performances. The same

4 To a great extent, this view – which is widespread in Western societies – rests on the emphasis of humans as created by and/or in the image of God, a view common in today's monotheistic religions that rank humans outside of, and most importantly, above «the animal world« (e.g. Bailey 2021). The biblical story of Adam and Eve addresses their becoming aware of their nakedness («And they knew that they were naked.«), after having eaten from the tree of knowledge (Genesis 3,1–24). In this context, nakedness also relates to being unknowledgeable and free from sin (cf. Heller 2003).

wilden Natur«[4] stellen. Aber schließen sich diese scheinbar dichotomen Perspektiven wirklich gegenseitig aus? Eine vermittelnde Perspektive würde Kultur als integralen Bestandteil der menschlichen Natur interpretieren. Sowohl in indigener Perspektive, aber auch in der westlichen, in der menschliches Denken und Handeln oft weitaus losgelöster von der natürlichen Umwelt zu sein scheinen als in einer indigenen, kann Kleidung als Ausdruck einer Suche nach Sinn verstanden werden. In verschiedenen Gesellschaften unterscheiden sich die Konzepte dessen, was Bedeutung verleiht, aber alle dienen dem Grundbedürfnis, individuelle und gruppenbezogene Identitäten zu schaffen und den Platz des Einzelnen und der Gruppe innerhalb unterschiedlicher übergeordneter Weltkonzepte zu definieren und so Bedeutung zu erzeugen (z. B. Crawford/Rossiter 2006; Negru-Subțirică u. a. 2016). Alle heutigen Gesellschaften scheinen Bühnen für vielfältige Formen der (öffentlichen) Darstellung und Übermittlung von Botschaften zu bieten, die Identitäten schaffen und prägen, wobei Kleidung und Kleidungsstil zu den wichtigsten Medien gehören. Dasselbe scheint für viele Gesellschaften in der späteren Vorgeschichte zu gelten (vgl. Beitrag Grömer in diesem Band; Grömer 2016).

**Sektion III** trägt den Titel »Kleidung als Mittel zum Schutz und Wohlbefinden«. Die hier versammelten Beiträge zielen darauf ab, biologische und psychologische Aspekte aufzuzeigen, die eng mit der körperlichen und geistigen Gesundheit verbunden sind. Die ersten beiden Beiträge in diesem Abschnitt befassen sich mit »Der Biologie der menschlichen Haut und Kleidung« (Sektion IIIa). C. de Guzman Strong charakterisiert die Hautbarriere des modernen Menschen als »innovative [Art von] Kleidung«, die einerseits vor der Sonne schützt und andererseits die Produktion von Vitamin D ermöglicht. Deutliche makroregionale Unterschiede in der Menge des epidermalen Proteins Involucrin bei heutigen Menschen deuten auf eine vergleichsweise junge Entwicklung außerhalb Afrikas hin, die höchstwahrscheinlich während der Ausbreitung neolithischer Gruppen nach Norden in Europa stattfand (Jablonski/Chaplin 2010). Das viel frühere Entstehen fast vollständig haarloser Haut und ihre Auswirkungen auf die Ursprünge der Kleidung in der frühen Menschheitsgeschichte werden von O. Jöris behandelt, der biologische, genetische und archäologische Indizien zusammenführt und das »Standardnarrativ«, das der Evolution der Kleidung zugrunde gelegt wird, infrage stellt. Der folgende Sektion IIIb – »Kleidung und das biopsychologische und mentale Wohlbefinden« – baut auf den vorangegangenen Erkenntnissen auf. Es ist plausibel und sogar wahrscheinlich, dass die Schambehaarung des Menschen, die ein Merkmal der geschlechtlichen Reifung ist, erst nach

4 Diese in westlichen Gesellschaften weit verbreitete Ansicht beruht weitgehend auf der Betonung des Menschen als Geschöpf und/oder Ebenbild Gottes, eine Sichtweise, die in den heutigen monotheistischen Religionen verbreitet ist, die den Menschen außerhalb und vor allem über der »Tierwelt« einordnen (z. B. Bailey 2021). Die biblische Geschichte von Adam und Eva handelt davon, wie sie sich ihrer Nacktheit bewusst werden (»Und sie erkannten, dass sie nackt waren«.), nachdem sie von dem Baum der Erkenntnis gegessen hatten (Genesis 3,1–24). In diesem Zusammenhang steht Nacktheit auch für Unwissenheit und Sündlosigkeit (vgl. Heller 2003).

seems to apply to many past societies in later prehistory (cf. Grömer in this volume; Grömer 2016).

**Section III** is titled »Clothing as a means of protection and well-being«. The contributions collected here aim at highlighting the complex reasons for clothing in regard to matters of biology and psychology that are closely linked to physical and mental health. The first two contributions in this section address »The biology of human skin and clothing« (Section IIIa). C. de Guzman Strong characterises our modern human skin barrier as an »innovative [type of] clothing« that protects against the sun on the one hand, while enabling the production of Vitamin D on the other. Marked macro-regional differences in the amount of the epidermal protein Involucrin among recent humans hint at a comparably recent selective sweep that appeared outside Africa, most likely during the northward spread of Neolithic groups into Europe (Jablonski/Chaplin 2010). The much earlier evolution of near-naked skin and its implications for the origins of clothing in our deep human history are addressed by O. Jöris, combining the biological, genetic, and archaeological evidence and questioning the ›standard narrative‹ underlying the evolution of clothing. The following Section IIIb – »Clothing and bio-psychological and mental well-being« – builds on the former findings, as it is plausible and even likely that human pubic hair, which is a feature of sexual maturation, evolved only after the loss of body hair[5]. As K. Junker explains in his contribution, pubic hair could then »serve as a quick indicator of a person's reproductive status«. This development is interpreted to have co-evolved with foundational changes in human mating systems (cf. van Schaik/Kunz in prep.). As the feeling of sexual shame also develops only from a certain individual age on, its biological underpinnings seem to be closely connected to changes in human sexuality, as mentioned above. Wulf Schiefenhövel interprets the universal use of genital cover as a bio-psychological impulse that likely will have evolved before clothing became a regular behavioural and cultural trait. Contrasting the more biologically oriented papers, the last contribution in sub-section IIIb by P. Vang Petersen refers to the spiritual-protective aspects of clothing and body decorations. As P. Vang Petersen shows, amber beads in Stone Age burials from Denmark can be interpreted as clothing elements by their position in burials and use-wear traces. They occur in the highest numbers with young women and children, hinting at a protective role for particularly vulnerable group members rather than an expression of status.

**Section IV** addresses »Materials and methods in clothing production«. The section is subdivided into four sub-sections, comprising Section IVa »Use and processing of animal resources«, Section IVb »Use and processing of plant resources«, Section IVc »Specialised tools and technologies«, and Section IVd »Clothing as comfort«. Although scientific arguments are mostly lacking, the use of skins and furs for the production of leather items or pelts is generally thought to predate the use of plant fibres.

5 Weiss 2007; Weiss 2009; cf. Reed et al. 2007 for a different interpretation.

dem Verlust der Körperbehaarung entstanden ist[5]. Wie K. Junker in seinem Beitrag erläutert, konnte die Schambehaarung dann »als schneller Indikator für den Fortpflanzungsstatus einer Person dienen«. Diese Entwicklung wird als Koevolution mit grundlegenden Veränderungen in den Paarungssystemen des Menschen interpretiert (vgl. van Schaik/Kunz in Vorb.). Da sich auch das Gefühl der sexuellen Scham erst ab einem bestimmten individuellen Alter entwickelt, scheint seine biologische Grundlage, wie oben erwähnt, eng mit Veränderungen in der menschlichen Sexualität verbunden zu sein. Wulf Schiefenhövel interpretiert die universelle Verwendung von Genitalbedeckungen als einen biopsychologischen Impuls, der sich wahrscheinlich entwickelt hat, bevor Kleidung zu einem regulären Verhaltens- und Kulturmerkmal wurde. Im Gegensatz zu den eher biologisch orientierten Beiträgen verweist der letzte Beitrag in Untersektion IIIb von P. Vang Petersen auf die spirituell-schützenden Aspekte von Kleidung und Körperverzierungen. Wie P. Vang Petersen zeigt, können Bernsteinperlen in Steinzeitgräbern in Dänemark aufgrund ihrer Position in den Gräbern und ihrer Gebrauchsspuren als Kleidungselemente interpretiert werden. Sie kommen am häufigsten bei jungen Frauen und Kindern vor, was eher auf eine Schutzfunktion für besonders gefährdete Gruppenmitglieder als auf einen Ausdruck von Status hindeutet.

**Sektion IV** befasst sich mit »Materialien und Methoden zur Herstellung von Kleidung«. Der Abschnitt ist in vier Unterabschnitte unterteilt, die Sektionen IVa »Verwendung und Verarbeitung tierischer Ressourcen«, IVb »Verwendung und Verarbeitung pflanzlicher Ressourcen«, IVc »Spezialwerkzeuge und -technologien« und IVd »Kleidung und Komfort«. Obwohl wissenschaftliche Argumente weitgehend fehlen, wird allgemein angenommen, dass die Verwendung von Häuten und Fellen für die Herstellung von Lederartikeln oder Pelzen älter ist als die Verwendung von Pflanzenfasern.

Mit Beginn der Jagd wurden auch tierische Ressourcen, die nicht der Ernährung dienten, regelmäßig verfügbar. Aufgrund der schlechten Erhaltung sind jedoch kaum Belege zur Art der Beschaffung von Tierhäuten vorhanden. Eine bemerkenswerte Ausnahme bildet ein Mammutkadaver, der über etwa 38 000–39 000 Jahre an einer Fundstätte in der Nähe von Jakutina, Republik Sacha (Russland), im sibirischen Permafrostboden erhalten geblieben ist. Dieser Mammutkadaver von Yuka weist zwei größere Löcher im Rücken auf. Während eines der Löcher (Nr. 2) an seinem Rand Nagespuren zeigt, ist Loch Nr. 1 durch einen scharfen, geraden Schnitt begrenzt (Abb. 3), der nur als Ergebnis menschlicher Tätigkeit erklärt werden kann (Akhmetgaleeva u. a. 2024). Im Gegensatz zur Beschaffung der Häute ist ihre Verarbeitung – möglicherweise zur Herstellung von Kleidung – viel besser dokumentiert. Entsprechende Gebrauchsspuren an Steinwerkzeugen sind verhältnismäßig häufig. Der vielleicht früheste Hinweis auf die Bearbeitung von Häuten stammt aus einer 780 000 Jahre alten Schicht in Atapuerca, Provinz Burgos, in Spanien, wie Gebrauchsspuren an einem Steinwerkzeug nahe-

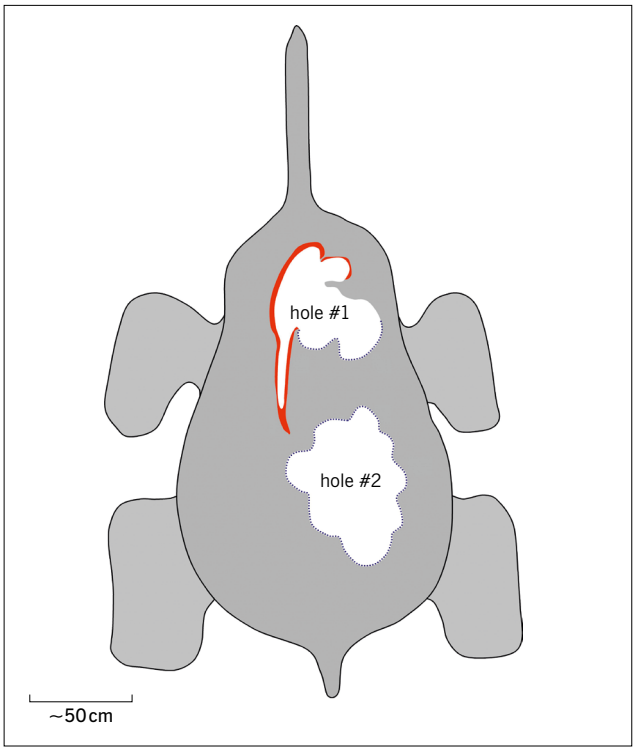


**Abb. 3** Gewinnung von Mammuthaut, rekonstruiert anhand anthropogener Spuren am Mammutkadaver von Yuka, Republik Sacha, in Sibirien (Russland), vor 38 000–39 000 Jahren. Der rot hervorgehobene Rand von Loch Nr. 1 weist scharfe künstliche Schnitte auf, während die lila gepunktete Umrandung um Teile von Loch Nr. 1 und um Loch Nr. 2 Nagespuren von Tieren anzeigen.

***Fig. 3*** *Mammoth hide procurement as indicated by anthropogenic traces on the Yuka, Sakha Republic (Russia), mammoth carcass in Sibiria, 38 000–39 000 years ago. The red area around hole no. 1 indicates sharp artificial cuts, whereas the purple dotted margins of parts of hole no. 1 and around hole no. 2 indicate animal gnawing marks.*

With the beginning of hunting, non-food animal resources also became regularly accessible. However, evidence for the procurement of animal skins is close to non-existent, due to the lack of preservation. A notable exception comes from a mammoth carcass that has been preserved at a site near Yakutina, Sakha Republic (Russia), in the Siberian permafrost for some 38 000–39 000 years. The Yuka mammoth carcass shows two larger holes in its back. Whereas one of the holes (no. 2) displays gnawing marks around its edge, hole no. 1 is delimited by a sharp, straight cut (Fig. 3), which can only be explained as resulting from human activity (Akhmetgaleeva et al. 2024). In contrast to their procurement, the processing of hides – potentially to produce clothes – is much better documented, as use-wear analyses of lithic artefacts frequently indicate. The earliest potential hint at hide working has been reported from a 780 000-year-old layer at Atapuerca, Province of Burgos, in Spain, indicated through use-wear traces found on a single lithic artefact (Carbonell et al. 1999). More convincing use-wear evidence, which indicates the systematic processing of hides around 450 000 years ago, comes from the level ALB-42 assemblage of the Valle Giumentina, Abruzzo, open-air site in Italy (Nicoud et al. 2022). Interestingly, this assemblage dates to the time of the most extreme Ice Age glaciation of northern Europe – the Anglian/Elsterian glaciation. Surviving this major climatic

5 Weiss 2007; Weiss 2009; vgl. Reed u. a. 2007 für eine andere Interpretation.

legen (Carbonell u. a. 1999). Überzeugendere Nachweise, die eine systematische Verarbeitung von Häuten vor etwa 450 000 Jahren belegen, stammen aus der Fundstätte ALB-42 im Valle Giumentina, Abruzzen, in Italien (Nicoud u. a. 2022). Bemerkenswerterweise datiert dieser Fundplatz in die Zeit der extremsten Vereisung Nordeuropas – der Elster-Kaltzeit, die auf den Britischen Inseln dem »Anglian« entspricht. Das Überleben in diesem extremen Klimaabschnitt in Europa erforderte möglicherweise völlig neue Anpassungen, darunter die Entwicklung geeigneter Kleidung; erst ab dieser Zeit lassen sich Hinweise auf die Verarbeitung von Häuten häufiger finden[6], unter anderem auch an der Fundstelle Schöningen, Lkr. Helmstedt, in Niedersachsen (Rots u. a. 2015; Venditti u. a. 2022). Hier berichtet I. Verheijen über Hinweise auf das Häuten von Karnivoren, das im paläolithischen Europa ab der Zeit vor etwa 500 000 Jahren zunehmend belegt ist (Parfitt 1999). Höchstwahrscheinlich wurden die Felle für Kleidung verwendet. Auf diesen Beitrag folgt ein Kapitel von T. Emmerich Kamper und L. Hurcombe über prähistorische Gerbtechniken, die zur Verarbeitung der Tierhäute erforderlich waren. Die Autorinnen haben eine Referenzsammlung mit über 200 Proben angelegt, um die Merkmale der sechs bedeutendsten Arten des Gerbens zu charakterisieren: das Nass- und Trockenkratzen unter Verwendung von Hirnmasse als Gerbstoff, die Rindengerbung, Alaungerbung, Uringerbung und die Rohhautgerbung. Die Vergleichsprobensammlung kann als Grundlage zur Bewertung archäologischer Funde dienen. In diesem Zusammenhang ist zu erwähnen, dass das Landesmuseum für Vorgeschichte in Halle auch ein bemerkenswertes, rund 125 000 Jahre altes Steinartefakt aus Neumark-Nord, Saalekreis, in Sachsen-Anhalt präsentiert, das in die letzte Warmzeit datiert, und auf dem sich Reste einer organischen Masse erhalten haben (Abb. 4). Diese Masse wurde als Gerbstoff interpretiert (Koller/Baumer 2010[7]). Pflanzenfaserreste auf einem Steinartefakt aus Schöningen mögen ebenfalls auf das Gerben von Fellen hinweisen, jedoch in einem deutlich älteren Kontext (vgl. Rots u. a. 2015). Analysen anderer Residuen deuten auf die Gewinnung von Tiersehnen und -bändern hin (siehe z. B. Venditti u. a. 2019), was auch durch entsprechende Schnittspuren vielfach belegt ist. Die mögliche Verwendung von Federn in der Kleidung oder als Körperschmuck wird im Beitrag von T. Kirkinen behandelt. Die Existenz dieser in der Regel nicht erhaltenen und daher meist nicht in Betracht gezogenen Fundkategorie kann durch mikroskopische Federfragmente, d. h. durch den Nachweis sogenannter *Barbulae*, belegt werden. Die Implikationen solcher Nachweise für die Interpretation von Bestattungskontexten werden anhand mesolithischer Beispiele aufgezeigt. Besonders interessant ist, dass in dem »Schamanengrab« von Bad Dürrenberg, Saalekreis, ausgestellt im Landesmuseum für Vorgeschichte Halle,

6 Z. B. Keeley 1993; Lemorini u. a. 2020; Groman-Yaroslavski u. a. 2022; Claud u. a. 2019.

7 Die in der Studie vorgestellten Analyseergebnisse sind jedoch laut dem Archäochemiker Christian-Heinrich Wunderlich (LDA; pers. Mitt.) mit Vorsicht zu betrachten.

event in Europe may have demanded entirely new adaptations, including the development of suitable clothing, and it is only after this period that evidence of hide processing has been traced more regularly[6], including the site of Schöningen, Helmstedt District, in Lower Saxony (Germany; Rots et al. 2015; Venditti et al. 2022). Here, I. Verheijen reports on the evidence for carnivore skinning, which becomes a regular behaviour in Palaeolithic Europe from c. 500 000 years on (Parfitt 1999). Most likely, carnivore pelts were frequently used for clothing. This contribution is followed by a chapter by T. Emmerich Kamper and L. Hurcombe on prehistoric tanning technologies required to process the animal hides. The authors have established a reference collection of over 200 samples to define characteristics of six widely attested tanning types: wet and dry scrape brain tan, bark tan, alum taw, urine tan and rawhide. These can serve as a baseline for comparison with archaeological finds. In this context it is worth mentioning that the State Museum of Prehistory in Halle also presents a remarkable lithic artefact found at the c. 125 000-year-old last interglacial site of Neumark-Nord, Saalekreis District, in Saxony-Anhalt on which residuals of an organic paste have survived (Fig. 4). This paste has been interpreted to have properties suitable for tanning (Koller/Baumer 2010)[7]. Plant fibre residues found on a lithic artefact from Schöningen may also hint at the potential use of tannage in an even older context (cf. Rots et al. 2015). Residue analysis also points to the extraction of animal tendons and ligaments (see e.g. Venditti et al. 2019), which is also indicated by butchery marks. The potential use of feathers in clothing or as body ornamentation is addressed in a contribution by T. Kirkinen. The existence of this regularly lost and therefore often overlooked find category can be proven by microscopic feather fragments, i.e. the barbules. The implications of such evidence for the interpretation of burial contexts are demonstrated using Mesolithic examples. Most interestingly, a total of 15 feather fragments could be detected in the Bad Dürrenberg »shaman's grave«, Saalekreis District, which is also displayed in the State Museum of Prehistory Halle. One of the feather fragments, located approximately at the skull level of the buried woman, was identified as belonging to a type of waterfowl, probably goose. This coincides with the famous reconstruction of the »shaman« by K. Schauer (Fig. 5), which includes feathers in her ornate headdress, thus highlighting the potential and the value of science-based artistic reconstructions in museums.

Section IVb centres on »Use and processing of plant resources« in the production of clothes. Again, resulting from preservation conditions that are better in more recent periods, the archaeological record of textiles or worked plant fibres is heavily biased towards the Holocene (e.g. Jørgensen 2013). Plant fibres rarely survive at early archaeological sites, and even if they are preserved, they are rarely studied (e.g. Nadel et al. 1994; Kvavadze

6 E.g. Keeley 1993; Lemorini et al. 2020; Groman-Yaroslavski et al. 2022; Claud et al. 2019.

7 However, the analytical results presented in the study should be met with caution, according to the archaeochemist Christian-Heinrich Wunderlich (LDA; pers. communication).

**Abb. 4** Reste einer organischen Masse auf einem Abschlag aus Neumark-Nord, Saalekreis, aus der letzten Warmzeit vor ca. 125 000 Jahren. Länge ca. 4,7 cm.

***Fig. 4*** *Residual organic paste preserved on a flake found at the last interglacial site of Neumark-Nord, Saalekreis District, dating to c. 125 000 years ago. Length c. 4,7 cm.*

insgesamt 15 Federfragmente gefunden wurden. Einer der Federreste, der sich etwa auf der Höhe des Schädels der bestatteten Frau befand, wurde als zu einer Wasservogelart, wahrscheinlich Gänsen, gehörig identifiziert. Dies stimmt mit der berühmten Rekonstruktion der »Schamanin« von K. Schauer überein (Abb. 5), die Federn in ihrem Kopfschmuck zeigt. Das Beispiel unterstreicht das Potenzial und den Wert wissenschaftlich fundierter künstlerischer Rekonstruktionen in Museen.

Sektion IVb konzentriert sich auf die »Verwendung und Verarbeitung pflanzlicher Ressourcen« bei der Herstellung von Kleidung. Auch die meisten archäologischen Funde von bearbeiteten Pflanzenfasern oder aus solchen gefertigter Textilien stammen aufgrund der besseren Erhaltungsbedingungen in jüngeren Zeiten aus dem Holozän (z. B. Jørgensen 2013). Pflanzenfasern sind an frühen Fundstätten selten erhalten, und selbst wenn sie erhalten sind, werden sie nur selten untersucht (z. B. Nadel u. a. 1994; Kvavadze u. a. 2009). Darüber hinaus gibt es eine Reihe methodischer Probleme in Untersuchungen zur Nutzung von Pflanzenfasern (z. B. Bergfjord u. a. 2010), die in dem Beitrag von V. Rots und S. Tomasso ausführlich diskutiert werden. Sie schlagen eine Methodik vor, um diese Schwierigkeiten in Zukunft zu überwinden und diskutieren die möglichen Belege für verdrillte Fasern, die in einem spätmittelpaläolithischen Zusammenhang in Frankreich entdeckt wurden, kritisch (Hardy u. a. 2020). Sie wären der bislang einzige potenzielle Hinweis auf fortgeschrittene Fasertechnologie an einer neandertalerzeitlichen Fundstelle. Entgegen der Kritik von V. Rots und S. Tomasso bewerten wir die von B. L. Hardy u. a. (2020) vorgelegten Belege aus dem Abri du Maras, Dép. Ardèche (Frank-

et al. 2009). In addition, there is a range of methodological problems underlying studies on the use of fibres (e.g. Bergfjord et al. 2010) which are discussed extensively in the contribution by V. Rots and S. Tomasso, who propose a methodology to overcome these difficulties in future. They also critically review the claimed evidence of twisted fibres discovered at a late Middle Palaeolithic context in France (Hardy et al. 2020), which is, to date, the only potential evidence of advanced fibre technology from a Neanderthal site. Against V. Rots's and S. Tomasso's criticism, we read the evidence from Abri du Maras, Ardèche Department (France), presented by B. L. Hardy et al. (2020) more positively, as the twined cord fragment discovered and shown in high-resolution SEM photographs appears to have been carbonised, and should therefore not represent recent intrusive material. Similarly, other fibres from the same layer seem to clearly belong to the same archaeological context, which is dated to c. 41 000–52 000 years BP. The acceptance of such early fibre technology, if confirmed by new finds and further analysis, would completely change the standard view of simply dressed archaic humans vs. modern humans in tailored, fitted clothes. E. IJsveld and D. Olthof elaborate in detail on fibre-based materials and techniques that can be used to produce Stone Age textiles. Examples of the range of items made of plant fibres are presented for late hunter-gatherer and Neolithic contexts. In one case, these impressive finds were preserved under dry conditions in a cave in Spain. M. Herrero-Otal and colleagues give an account of the remarkable finds from the Cueva de los Murciélagos, Province of Córdoba, in southern Iberia. This site provides some of the oldest fibre-based

**Abb. 5** Rekonstruktion der »Schamanin« von Bad Dürrenberg, Saalekreis, durch Karol Schauer im Landesmuseum für Vorgeschichte Halle (Saale).

***Fig. 5*** *Reconstruction of the female »shaman« of Bad Dürrenberg, Saalekreis District, by Karol Schauer at the State Museum of Prehistory Halle (Saale).*

reiche), positiver, da das entdeckte und in hochauflösenden SEM-Fotografien gezeigte fragmentierte Stück Schnur karbonisiert zu sein scheint und daher kein jüngeres intrusives Material darstellen dürfte. Ebenso scheinen andere Fasern aus derselben Schicht eindeutig zum gleichen archäologischen Kontext zu gehören, der auf ca. 41 000–52 000 Jahre vor heute datiert wird. Die Akzeptanz einer derart frühen Fasertechnologie würde, sofern sie durch neue Funde und weitere Analysen bestätigt wird, die gängige Sichtweise von einfach gekleideten archaischen Menschen im Gegensatz zu modernen Menschen in maßgeschneiderter, passgenauer Kleidung völlig verändern. E. IJsveld und D. Olthof gehen ausführlich auf faserbasierte Materialien und Techniken ein, die zur Herstellung von Textilien in der Steinzeit verwendet worden sein könnten. Beispiele für die Bandbreite der aus Pflanzenfasern hergestellten Gegenstände werden für späte Jäger-Sammler und neolithische Kontexte vorgestellt. In einem Fall haben sich solche beeindruckenden Funde unter trockenen Bedingungen in einer Höhle in Spanien erhalten. M. Herrero-Otal und Kollegen berichten über bemerkenswerte Funde aus der Cueva de los Murciélagos, Provinz Córdoba, im Süden der

materials from late hunter-gatherer and early farming communities of southern Europe. M. Mineo and colleagues present the finds from the other crucial site that has produced such evidence: the Early Neolithic underwater site of La Marmotta in Lake Bracciano (Anguillara Sabazia, Lazio) in Italy, which includes textiles, footwear and basketry. Both studies show impressively that a too-restrictive use of the term ›clothing‹ limits our view on how widely such fibre-based technologies have been applied: once threads, yarns, or braids are in use, they can serve, for example, for the production of basketry, which requires the same materials and similar technology as is used for manufacturing clothing items.

Section IVc highlights »Specialised tools and technologies«, relevant in the production of clothing. Besides the topics that address dedicated tools from Stone Age contexts, the two last contributions refer to technologies exemplified by case studies from later periods. The reason to include these studies in the present volume is simply the fact that the materials used are also known from Stone Age periods, but are rarely documented or studied

Iberischen Halbinsel. Diese Fundstätte erbrachte einige der ältesten faserbasierten Materialien aus späten Jäger-Sammler- und frühneolithischen Gemeinschaften Südeuropas. M. Mineo und Kollegen präsentieren Funde einer weiteren wichtigen Fundstätte, die solche Zeugnisse hervorgebracht hat: die frühneolithische Siedlung von La Marmotta, von der – unter dem Wasserspiegel des Braccianosees in Italien (Anguillara Sabazia, Latium) konserviert – Textilien, Schuhwerk und Korbwaren in ausgezeichneter Erhaltung überliefert sind. Beide Studien zeigen eindrucksvoll, dass eine zu restriktive Verwendung des Begriffs »Kleidung« unseren Blick darauf einschränkt, wie breit gefächert deratige faserbasierte Technologien angewendet werden konnten: Sobald Fäden, Garne oder Flechtwaren verwendet werden, können sie beispielsweise für die Herstellung von Körben dienen, für die dieselben Materialien und ähnliche Technologien wie für die Herstellung von Kleidungsstücken erforderlich sind.

Sektion IVc befasst sich mit »Spezialwerkzeugen und -technologien«, die für die Herstellung von Kleidung relevant sind. Neben Themen, die sich mit speziellen Werkzeugen aus der Steinzeit befassen, beziehen sich die letzten beiden Beiträge auf Technologien, die anhand von Fallstudien aus späteren Epochen veranschaulicht werden. Der Grund für die Aufnahme dieser Studien in den vorliegenden Band liegt darin, dass die verwendeten Materialien auch aus der Steinzeit bekannt sind, jedoch nur selten dokumentiert oder detailliert untersucht wurden. A. van Gijn beginnt diesen Abschnitt mit einer Gebrauchsspurenuntersuchung an Knochenartefakten, die im mesolithischen Grab der »Schamanin von Bad Dürrenberg« gefunden wurden (Orschiedt u. a. 2023; Dietl u. a. 2024). Diese komplexe Bestattung ist eines der wichtigsten Exponate im Landesmuseum für Vorgeschichte Halle. Während viele mesolithische Bestattungen nur wenige oder gar keine Grabbeigaben enthalten, umfasst der äußerst reichhaltige Fundbestand des »Schamanengrabs« sechs Knochenwerkzeuge, die Teil eines speziellen Werkzeugsatzes zur Verarbeitung pflanzlicher Materialien zu Körben oder Kleidungsstücken sind. Es folgen zwei Beiträge zu dem wohl ikonischsten Spezialgerät, das (nicht nur) zur Herstellung von Kleidung verwendet wurde: die Nadel mit Öhr, die in der Steinzeit meist aus Knochen gefertigt wurde, obwohl auch steinerne Varianten dieses Werkzeugtyps bekannt sind (Chen u. a. 2024). Während M. Borao Álvarez und Kollegen in ihrem Beitrag das Aufkommen und die Herstellung von Nadeln mit Öhr in ganz Eurasien und bis nach Nordamerika nachzeichnen, konzentrieren sich A. W. Kandel und Kollegen auf einen einzigen Fund einer Nadel mit Öhr im Kaukasus und heben den komplementären Charakter der Nadel- und Faden-Technologie hervor, die weit mehr umfasst als nur die Nadel allein (s. o. Sektion IVb). Erwähnenswert ist, dass steinzeitliche Nadeln aus organischem Material äußerst zerbrechlich sind. Es ist daher sehr wahrscheinlich, dass – wie in der modernen Schuhherstellung – Leder mit anderen Werkzeugen als einer Nadel vorbereitet und perforiert oder gestanzt wurde, bevor ein Faden dann mittels einer Nadel durch das gestanzte Loch geführt wurde. Ein fast 40 000 Jahre altes »Stanzbrett« aus dem Jungpaläolithikum Nordspaniens, das offenbar als eine Art Amboss für solche Arbeiten diente, wurde von L. Doyon u. a. (2023) beschrieben. Bemerkenswerterweise tauchen Nadeln mit Öhr in dieser Region erst viel später auf, was darin detail. A. van Gijn begins this section with a use-wear study of bone artefacts found in the Mesolithic grave of the female »shaman of Bad Dürrenberg« (Orschiedt et al. 2023; Dietl et al. 2024). This complex burial and its interpretation make it one of the most enigmatic features on display in the State Museum of Prehistory Halle. While many Mesolithic burials have only a few or no grave goods, the extremely rich inventory of the »shaman's« grave includes six bone tools that form part of a particular toolkit for working plant-based materials into baskets or garments. This contribution is followed by two papers on the most iconic tool involved (not only) in the production of clothes: the eyed needle, which is mostly made of bone in Stone Age contexts, although some stone versions of this type of implement are known (Chen et al. 2024). Whereas M. Borao Álvarez and colleagues trace the appearance and production of eyed needles throughout Eurasia and into North America in their contribution, A. W. Kandel and colleagues focus on a single find of an eyed needle in the Caucasus mountains and highlight the complementary character of needle-and-thread technology, which involves much more than the needle alone (see above Section IVb). It is noteworthy that Stone Age needles made of organic material are extremely fragile. It is highly likely that – as in modern shoemaking – leather is prepared and perforated or punched with tools other than a needle, before a thread is lead through the punched hole. An almost 40 000-year-old early Upper Palaeolithic »punching board«, which seems to have functioned as a kind of anvil for performing such punching tasks, has been reported by L. Doyon et al. (2023) from northern Spain. Interestingly, eyed needles appear much later in this region, which may indicate that threads or tendons may have been used without the use of eyed needles. This, like the tentative evidence for early fibre technologies in the late Middle Palaeolithic, allows speculation as to whether fitted or tailored clothing could have been in use much earlier than generally assumed (cf. Gilligan; Jöris [Section III] in this volume). Nevertheless, the use of eyed needles is especially necessary when sewing pelts and when the thread must be guided through (sometimes thick) long-haired fur. At the Paleoindian site of La Prele, Wyoming, in the United States of America, eyed needles are exclusively made of the bones of small and medium sized fur-bearing animals (Pelton et al. 2024), which prompts speculation concerning potentially close cosmological ties between the tools used (needles from fur-bearing animals) and the furs processed (cf. Hussain in this volume; cf. Fig. 6). It seems that during the extremely cold Younger Dryas better quality clothing to protect against the harsh climate was required in the region. The potential use of wild flax – although not uncontested – may be as old as 30 000 years (see above). As not much is known about how flax was processed in prehistory, S. Friederich and colleagues report on potential flax retting pits from a Roman Iron Age site in Saxony-Anhalt, offering insights into the technology and the scale required for systematic and regular flax production. Their detailed description of the rather inconspicuous pit features involved in flax processing may serve as a baseline to securely interpret similar finds in the future. The last

auf hindeuten könnte, dass Fäden oder Sehnen ohne Nadeln mit Öhr verwendet wurden. Dies lässt im Zusammenspiel mit den Hinweisen auf mögliche neanderthalerzeitliche Fasertechnologien spekulieren, ob passgenaue oder maßgeschneiderte Kleidung möglicherweise viel früher als allgemein angenommen hergestellt und eingesetzt wurde (vgl. Beiträge Gilligan; Jöris [Sektion III] in diesem Band). Dennoch ist die Verwendung von Nadeln mit Öhr insbesondere dann notwendig, wenn (manchmal dichte und dicke) Pelze vernäht werden und Fäden durch langhaarigen Pelz zu führen sind. An der paläoindianischen Fundstätte La Prele, Wyoming, in den Vereinigten Staaten von Amerika sind Nadeln mit Öhr ausschließlich aus den Knochen kleiner und mittelgroßer Pelztiere hergestellt worden (Pelton u. a. 2024), was Spekulationen über möglicherweise enge kosmologische Verbindungen zwischen den verwendeten Werkzeugen und den verarbeiteten Pelzen anregt (vgl. Beitrag Hussain in diesem Band; vgl. Abb. 6). Es scheint, dass während der extrem kalten Jüngeren Dryaszeit in der Region hochwertigere Kleidung zum Schutz vor dem rauen Klima benötigt wurde. Die mögliche Verwendung von Wildflachs – wenn auch nicht unumstritten – könnte bis zu 30 000 Jahre zurückreichen (s. o.). Da über die Verarbeitung von Flachs in der Vorgeschichte nur wenig bekannt ist, berichten S. Friederich und Kollegen über mögliche Flachs-Rottegruben aus einer Fundstätte der Römischen Kaiserzeit in Sachsen-Anhalt, die Einblicke in die Technologie und den Umfang einer systematischen Flachsproduktion geben. Ihre detaillierte Beschreibung der eher unscheinbaren Grubenan-

contribution by M. Görlitz on spindle whorls at the Roman Iron Age settlement of Feddersen Wierde, Cuxhaven District, in northern Germany is an in-depth study of a find category that is markedly understudied so far. An integrative approach combining use-wear analysis and a series of experiments widens the range of items that could be used as whorls. Neither a regular shape nor an exactly centred perforation is necessary for an object to serve as a spindle whorl. Also, the whorls' weight is not a decisive factor for yarn thickness, although this has frequently been claimed. The results of the study provides much food for thought on the design and function of hand spindles in Stone Age contexts and about items that could be used as spindle whorls.

The contribution entitled »Cloth as human experience« by S. Harris and A. Palyvos in Section IVd »Clothing as comfort« goes beyond the plain functional aspects of clothing and its production. Experiments to process animal as well as plant materials for use in clothing are at the centre of the study, which is supplemented by a series of experiments to determine how the processed materials would be experienced with regard to haptics and texture, visual appearance, smell, and sound. The studies' participants' subjective judgements show that the individual feeling of being comfortable with the material properties of the products plays an essential role beyond functionality – up until today!

**Section V** presents case studies for »Clothing and body ornamentation« during different periods of the Stone

**Abb. 6** Eine ca. 40 000 Jahre alte Elfenbeinschnitzerei aus der Aurignacien-Fundstätte Vogelherd, Lkr. Heidenheim, die wahrscheinlich einen Höhlenlöwen darstellt. Über die tiefere Bedeutung der Skulptur kann man nur spekulieren. Zeigt sie lediglich, wie das Tier aussieht, oder enthält sie weitere Informationen? Auch wenn dies reine Spekulation ist, mag man überlegen, ob die Punzmarkierungen, die die Figur zieren, nicht nur darauf hinweisen, dass es sich um einen Löwen handelt, sondern vielleicht auch darauf, dass Löwen eine beliebte Quelle für die Gewinnung von Fellen waren. Länge: 5,6 cm.

***Fig. 6*** *A c. 40 000-year-old ivory sculpture from the Aurignacian site of Vogelherd, Heidenheim District, likely representing a cave lion. One can only guess about the sculpture's deeper meaning. Does it just show how the animal's looks, or is there more information here? Although speculative, one may consider whether the punch marks that decorate the figurine not only indicate that this is a lion, but also that this species has probably been a favourite source of furs. Length: 5.6 cm.*

lagen, die mit der Flachsverarbeitung in Verbindung stehen, mag zukünftig als Grundlage für die Interpretation ähnlicher Befunde dienen. Der letzte Beitrag von M. Görlitz über Spinnwirtel aus der Römischen Kaiserzeit in Feddersen Wierde, Lkr. Cuxhaven, in Norddeutschland ist eine eingehende Untersuchung einer bisher deutlich vernachlässigten Fundgruppe. Ein integrativer Ansatz, der Gebrauchsspurenanalysen mit einer Reihe von Experimenten kombiniert, erweitert das Spektrum der Gegenstände, die als Spinnwirtel verwendet werden konnten. Denn weder eine regelmäßige Form, noch eine exakt zentrierte Lochung sind notwendig, damit ein Gegenstand als Spinnwirtel dienen kann. Auch ist das Gewicht der Wirtel kein entscheidender Faktor für die Garnstärke, wie gelegentlich gemutmaßt wurde. Die Ergebnisse dieser Studie geben viel Stoff zum Nachdenken über die Gestalt und Funktion möglicher Handspindeln in steinzeitlichen Befunden und über Gegenstände, die als Spinnwirtel verwendet werden konnten.

Der Beitrag »Stoff als menschliche Erfahrung« von S. Harris und A. Palyvos in Sektion IVd »Kleidung und Komfort« geht über die rein funktionalen Aspekte von Kleidung und deren Herstellung hinaus. Im Mittelpunkt der Studie stehen Experimente zur Verarbeitung von tierischen und pflanzlichen Materialien für die Verwendung für Kleidung, ergänzt durch eine Reihe von Experimenten, um zu ermitteln, wie die verarbeiteten Materialien in Bezug auf Haptik und Textur, optisches Erscheinungsbild, Geruch und Klang wahrgenommen werden. Die subjektiven Urteile der Teilnehmer an den experimentellen Teilen der Studie zeigen, dass das individuelle Wohlbefinden mit den Materialeigenschaften der Produkte über die Funktionalität hinaus eine wesentliche Rolle spielt – bis heute!

**Sektion V** präsentiert Fallstudien zu »Kleidung und Körperschmuck« aus verschiedenen Zeitabschnitten der Steinzeit mit regionalem oder fundstättenbezogenem Fokus. Die meisten Beiträge befassen sich mit Schmuck, der wohl auf Kleidung aufgenäht wurde, wie Grabbefunde deutlich zeigen (Sektion VI). S. Wolf und N. J. Conard betrachten die Funde aus dem südwestdeutschen Jungpaläolithikum in einer diachronen Perspektive und arbeiten die regionalen »Modetrends« und ihre Veränderung über längere Zeitabschnitte hinweg heraus. Doppelt-perforierte Perlen aus Mammut-Elfenbein sind die häufigsten Schmuckobjekte im Aurignacien, während das Gravettien durch tropfenförmige Perlen aus dem gleichen Material gekennzeichnet ist. Nach dem letzteiszeitlichen Kältemaximum ersetzen Mollusken und Gagat einen Teil der Rohstoffe, die zuvor für die Schmuckherstellung verwendet wurden. Durchlochte Zähne von Karnivoren sind in allen Perioden von Bedeutung. S. Guo und Kollegen diskutieren die charakteristischen doppelt-perforierten Elfenbeinperlen aus dem frühen Aurignacien genauer und stellen verschiedene Möglichkeiten vor, wie diese Perlen angeordnet werden konnten, um ihre optische Wirkung zu verstärken. M. Street und E. Turner befassen sich mit der Herstellung von Schmuck und Kleidung auf der Grundlage von Funden der beiden spätmagdalénienzeitlichen Fundstellen Gönnersdorf, Lkr. Neuwied, und Andernach-Martinsberg, Lkr. Mayen-Koblenz, am Mittelrhein. Die Hinweise auf Kleidung sind meist indirekter Natur: Nadeln, Schmuck, Gebrauchsspuren an Steingeräten, die auf die Bearbeitung von Häuten hindeuten, und Schnitt-

Age archaeological record with a regional or site-specific focus. Most of the contributions address personal ornaments, which are interpreted as mostly sewn onto clothing, as is well-indicated by burial sites (Section VI). S. Wolf and N. J. Conard review the south-western German Upper Palaeolithic record in a diachronic perspective and highlight the regional »fashion trends« that changed with time. Double-perforated mammoth ivory beads dominate the archaeological inventories of the Aurignacian, while the Gravettian is characterised by teardrop-shaped beads from the same material. Following the Last Glacial Maximum, molluscs and jet replace some of the raw materials previously used in the production of personal ornaments. Perforated carnivore teeth are important throughout all periods. S. Guo and colleagues discuss the distinct early Aurignacian double-perforated ivory bead in more detail and present different potential ways to arrange these beads to enhance visual effects. M. Street and E. Turner address the production of personal ornaments and clothing based on finds from the Late Magdalenian sites of Gönnersdorf, Neuwied District, and Andernach-Martinsberg, Mayen-Koblenz District, in the Central Rhineland of Germany. Evidence for clothing is mostly indirect: needles, ornaments, use-wear on scraping tools that hints at hide-working, and cut marks on horse phalanges that indicate the retrieval of ligaments possibly used for making threads; a preponderance of black and white feathers in the avifauna of the two sites points to the importance of such plumage, adding to the spectrum of colours that may have been involved in clothing and body decoration. The last contribution in this section, by A. Hafner, compiles the finds of actual clothes that have survived over millennia, submerged in Alpine sites. This paper not only shows what we are missing in all the cases of less favourable preservation conditions, but also how extensive Neolithic »wardrobes« must have been. Given that waterlogged sites mostly preserve plant materials only, whereas glacial sites complementarily preserve items made of animal materials, the complete record must have been even richer, involving a wide array of technologies to process the raw materials into clothes.

**Section VI** addresses the evidence for clothing from burial sites and asks for the relationship between »Stone Age clothing and social differentiation as seen from burial contexts«. The 34 000-year-old site of Sunghir in Russia provides impressive examples with its rich burials. Thousands of ivory beads and other types of personal ornaments were attached to the garments, allowing the reconstruction of highly ornamented ensembles, each composed of different clothing items such as coats and leggings-like ›trousers‹ (e.g. Trinkaus/Buzhilova 2018; cf. Gilligan in this volume). The mid-Upper Palaeolithic ›Gravettian‹ burial record represents the period of the Upper Palaeolithic that is richest in burials, showing both remarkable similarities and noticeable differences between the various finds. Taken together, this record represents an entire Gravettian »wardrobe«, which has been used for reconstructions in documentaries, as P. Coste and G. Giacobini detail in this volume. The ARTE documentary ›Ladies and Princes of Prehistory‹ (2021) was shown during the conference in

spuren an Pferdephalangen, die auf die Gewinnung von Sehnen schließen lassen, die möglicherweise zur Herstellung von Fäden verwendet wurden; der große Anteil schwarz sowie weiß gefiederter Vögel in der Avifauna der beiden Fundstellen weist auf die Bedeutung solcher Federn hin und ergänzt das Spektrum an Farben, die möglicherweise bei der Kleidung und Körperverzierung eine Rolle gespielt haben. Der letzte Beitrag in diesem Abschnitt von A. Hafner fasst die Funde erhaltener Kleidungsstücke zusammen, die über Jahrtausende in alpinen Fundstätten unter Wasser konserviert überdauerten. Dieser Beitrag zeigt nicht nur, was uns im Falle weniger günstiger Erhaltungsbedingungen fehlt, sondern auch, wie umfangreich die »Garderoben« der Jungsteinzeit gewesen sein müssen. Da in Feuchtboden- oder Unterwasserfundsituationen meist nur pflanzliche Materialien überdauern, während Gletscherstandorte ergänzend Gegenstände aus tierischen Materialien erhalten, dürfte die Gesamtheit der Kleidungsarten dieser Zeit ursprünglich noch viel umfangreicher gewesen sein und ein breites Spektrum an Technologien zur Verarbeitung der für die Herstellung von Kleidung geeigneten Rohstoffe umfasst haben.

**Sektion VI** befasst sich mit den Belegen von Kleidung in Bestattungskontexten und der Frage nach den Beziehungen von »Kleidung und soziale Differenzierung in der Steinzeit im Spiegel von Grabbefunden«. Die 34 000 Jahre alte Fundstelle Sunghir in Russland liefert mit ihren reichhaltigen Grabbeigaben eindrucksvolle Beispiele dafür. Tausende von Perlen aus Elfenbein und andere Schmuckobjekte waren an den Kleidungsstücken befestigt, sodass sich reich geschmückte Grabensembles rekonstruieren lassen, die jeweils aus verschiedenen Kleidungsstücken wie Mänteln und leggingsähnlichen »Hosen« bestanden (z. B. Trinkaus/Buzhilova 2018; vgl. Beitrag Gilligan in diesem Band). Die Bestattungen aus dem Mittleren Jungpaläolithikum, dem sogenannten Gravettien, stellen die reichhaltigsten Quellen zur jungpaläolithischen Bekleidung dar und zeigen sowohl bemerkenswerte Ähnlichkeiten als auch auffällige Unterschiede zwischen den verschiedenen Grabbefunden auf. Zusammengenommen bilden diese Funde eine komplette »Gravettien-Garderobe« ab, die auch als Grundlage für Rekonstruktionen in Dokumentarfilmen herangezogen wurde, wie P. Coste und G. Giacobini in diesem Band ausführlich beschreiben. Die ARTE-Dokumentation »Ladies and Princes of Prehistory« (2021) wurde während der Konferenz in Halle gezeigt und löste eine intensive und fruchtbare Diskussion aus. M. Vanhaeren vergleicht verschiedene Kinderbestattungen aus dem Jungpaläolithikum in Hinblick auf ihre Gestaltung sowie auch die Anordnung von Schmuckobjekten und interpretiert diese hinsichtlich einer Thematik um »Schönheit, Ästhetik und die ›Prinzipien der Kunst‹«. Hierbei spielen die Suche nach Neuheit und Überraschung, das Gleichgewicht zwischen den einzelnen Teilen und dem Ganzen, Symmetrie, Wiederholung, Übertreibung, Farbspiel und vermittelte Emotionen mit ein. Alter und Geschlecht, sozialer Status und die Intensität der Fürsorge und der Trauer der sozialen Gruppe werden als Faktoren für den Reichtum und die Anordnung von Schmuckelementen auf der Kleidung identifiziert. K. Mannermaa und R. Rainio diskutieren Ähnlichkeiten und Unterschiede zwischen den verschiedenen Bestattungen auf dem großen mesolithischen Friedhof von Yuzhniy Oleniy Ostrov, Republik Karelien, im Halle, prompting in-depth discussion. M. Vanhaeren compares different Upper Palaeolithic child burials, based on burial layout and associated personal ornaments, and interprets these along the wider topic of »beauty, aesthetics and the ›principles of art‹« to which the search for novelty and surprise, equilibrium between the parts and the whole, symmetry, repetition, exaggeration, colour play, and shared emotions add. Age and sex, social status, and the intensity of the social group's care and grief are identified as factors in the richness and arrangement of ornaments on clothes. K. Mannermaa and R. Rainio discuss similarities and differences in burial for the large Mesolithic burial ground of Yuzhniy Oleniy Ostrov, Republic of Karelia, in north-western Russia, where the authors compare the amount and location of personal ornaments found within specific burials. Animal tooth pendants were the most important ornaments. Their form suggests that the teeth of Eurasian elk and bear were suspended, while those of beaver were firmly attached to garments. K. Mannermaa and R. Rainio stress that we are most likely dealing with burial dress rather than everyday clothes. This observation may have consequences for many of the finds discussed, as we are often dealing with burial evidence or special sites. A special case in this regard, presented and discussed during the conference, are the so-called funerary bundles from the Pre-Pottery Neolithic B (8$^{th}$ millennium BC) occupation at Tell Halula in the Raqqa Governorate of Syria (Ortiz et al. 2013). Here, the team around the excavator Miquel Molist makes a strong case in favour of textiles, basketry and mats used specifically as wrappings for the deceased. Burial shafts were dug into the dwelling floors where the dead were buried in seated position wrapped in mostly bottle shaped textile bundles. Like in several of the older burial contexts discussed above, animal teeth played an important role in the late Neolithic of the Saale-Unstrut region of Central Germany, which has produced a series of burials of females with a highly symbolic grave gift: a ›pouch‹ embroidered with dog teeth. S. Friederich and colleagues publish for the first time a comprehensive catalogue of these finds and propose an interpretation as high-status items. T. Uthmeier asks whether or not changes in social organisation can be recognised through the comparative study of Magdalenian and Mesolithic burials and grave goods This question is particularly relevant in light of recent research showing that this period was characterised by a major population turnover that can be traced throughout most of Europe, during which the Late Upper Palaeolithic population, including the Magdalenians, was largely replaced by a Late Palaeolithic-Mesolithic one (cf. Posth et al. 2023). According to T. Uthmeier's interpretation, the former may have been more egalitarian, the latter more hierarchically organised.

**Section VII** addresses »Clothing and body ornamentation in Stone Age artistic contexts«. Figurines become part of the material culture starting from the Upper Palaeolithic; clay images of the human body are a hallmark of the Neolithic in many regions. They differ widely in the way the human body is depicted in time and space – however, quite a number of figurines have elaborate decorations that could represent clothing, ornaments, or body decorations

Nordwesten Russlands, wo die Autorinnen die Menge und Lage von Schmuckobjekten in bestimmten Gräbern vergleichen. Tierzahn-Anhänger waren die häufigsten Schmuckobjekte. Die Art ihrer Befestigung lässt vermuten, dass die Zähne von Eurasischem Elch und Bär hängend getragen wurden, während die von Bibern fest auf Kleidungsstücke genäht waren. K. Mannermaa und R. Rainio betonen, dass es sich höchstwahrscheinlich um Totengewänder und nicht um Alltagskleidung handelt. Diese Beobachtung könnte Konsequenzen für viele der diskutierten Funde haben, da es sich oft um Grabbeigaben oder besondere Fundstätten handelt. Ein spezieller Fall in dieser Hinsicht, der während der Konferenz vorgestellt und diskutiert wurde, behandelt die sogenannten Bestattungsbündel von Tell Halula, Gouvernement Raqqa (Syrien; Pre-Pottery Neolithic B, 8. Jt. v. Chr.; Ortiz u. a. 2013). Das Team um den Ausgräber Miquel Molist hat hier überzeugend dargelegt, wie Textilien, Korbwaren und Matten speziell im Grabritus genutzt wurden. Die Toten wurden in sitzender Postion, eng umwickelt in etwa flaschenförmigen Bündeln unter den Böden der Wohnhäuser beigesetzt. Wie in mehreren der oben besprochenen älteren Bestattungskontexte spielten Tierzähne im späten Neolithikum der Saale-Unstrut-Region in Mitteldeutschland auch eine wichtige Rolle. In dieser Region wurden einige Frauen mit einer höchst symbolträchtigen Beigabe bestattet: eine mit Hundezähnen bestickte »Tasche«. S. Friederich und Kollegen legen hier erstmals einen umfassenden Katalog dieser Funde vor und interpretieren die Taschen als Statussymbole. T. Uthmeier fragt, ob sich in der Gegenüberstellung der Beigaben aus magdalénienzeitlichen und mesolithischen Bestattungen soziale Veränderungen festmachen lassen. Diese Frage ist besonders relevant vor dem Hintergrund neuerer Forschungen, die zeigen, dass diese Periode in fast ganz Europa durch einen umfassenden Bevölkerungsumbruch gekennzeichnet ist, in dessen Verlauf die spätjungpaläolithische Bevölkerung, einschließlich der des Magdaléniens, von einer spätpaläolithisch-mesolithischen abgelöst wurde (vgl. Posth u. a. 2023). Gemäß T. Uthmeiers Interpretation waren erstere möglicherweise egalitärer, letztere eher hierarchisch organisiert.

**Sektion VII** befasst sich mit »Kleidung und Körperschmuck in steinzeitlichen künstlerischen Kontexten«. Figurinen sind ab dem Jungpaläolithikum Teil der materiellen Kultur; anthropomorphe Tonfigurinen bilden in vielen Regionen ein Charakteristikum des Neolithikums. Die Art und Weise, wie der menschliche Körper dargestellt wird, unterscheidet sich stark in Zeit und Raum – jedoch weisen zahlreiche Figurinen aufwendige Verzierungen auf, die Kleidung, Schmuckobjekte oder Körperverzierungen wie Tätowierungen oder Narben darstellen könnten. Drei Studien befassen sich eingehend mit diesem Themenfeld. O. Jöris gibt einen Überblick über die künstlerischen Darstellungen von Kleidungsstücken im eurasischen Paläolithikum und Mesolithikum und hebt dabei die Bedeutung textiler Bekleidung hervor. C. Marangou setzt diese Analyse mit einer Untersuchung des Aussehens und der Wahrnehmung von Figurinen aus dem Neolithikum Griechenlands fort. Nicht wenige Beiträge des vorliegenden Bandes werfen die Frage auf, ob wir anhand unserer archäologischen Quellen tatsächlich Alltagskleidung erfassen oder vielmehr, speziell für Bestattungen angefertigte Kleidungsstücke. O. Dietrich diskutiert diese Frage anhand like tattoos or scarification. Three studies explore this field in more detail. O. Jöris provides an overview of the Eurasian Palaeolithic to Mesolithic record of artistic depictions of clothing items, highlighting the amount of cord-work and textiles. C. Marangou continues with an analysis of the appearance and perception of figurines from Neolithic Greece. Quite a few papers in the present volume raise the question of whether we really capture everyday clothing through our archaeological sources, or rather, according to their nature, costumes made specifically for burials. O. Dietrich discusses this question for a very special group of sources: the anthropomorphic T-shaped pillars of Göbekli Tepe, Şanlıurfa Province (Turkey), and other Upper Mesopotamian sites. Their reliefs show animals and clothing items that are likely to be highly symbolic, referring to shaman costumes within an animistic ontology. The final contribution, by S. Kaner, discusses clothing depicted on ceramic figures from the Jōmon culture on the Japanese islands. Reconstruction of clothes based on this evidence plays a major role in the construction of history as well as the heritigisation of Jōmon archaeology currently ongoing in Japan.

Although not a systematic review of all available evidence or a comprehensive history of clothing in the Stone Age, the contributions in the present volume outline the state of knowledge, analytical approaches, as well as possible future lines of inquiry in this area of research. Clothing remains an understudied subject for many Stone Age periods. As the overview presented here shows, this is only partly due to an absence of evidence. Further emphasis on use-wear studies and residue analysis in combination with controlled archaeological experiments is certainly one approach to supplement the sparse archaeological record. Another significant result of the assembled papers and conference discussions was the recognition of how strongly archaeological reconstructions in museums and media inform and impact public perceptions of our prehistory. Portraits of naked or roughly clothed prehistoric individuals lead to derogatory perceptions of our ancestors' skills and mental capabilities. It is therefore highly important that actual research on prehistoric clothing be incorporated in such reconstructions: this is a further aim of the volume at hand.

## Acknowledgements

Our sincere thanks go to Claudia Gärtner who gave significant assistance and support in organizing the conference and who, with her team of kind (student) volunteers, always helped, constantly managing the event in the background to make it technically running as smooth and perfect as possible; she is also personally warm-hearted and intellectually inspiring. We would also like to thank the Martin Luther University Halle-Wittenberg and the Verein zur Förderung des Landesmuseums für Vorgeschichte Halle (Saale) for their support. We particularly thank Manuela Schwarz, Anne Gottstein, Birte Janzen, Florian Michel, Britta Stein, Rocco Steputat, and Aniela Schuchardt for the organisational, editorial and layout

einer ganz besonderen Gruppe von Quellen: den anthropomorphen T-förmigen Pfeilern vom Göbekli Tepe, Provinz Şanlıurfa (Türkei), und anderen obermesopotamischen Fundstätten. Deren Reliefs zeigen Tiere und Kleidungsstücke, die wahrscheinlich einen hohen symbolischen Wert haben und auf Schamanentrachten im Rahmen einer animistischen Ontologie verweisen. Der letzte Beitrag von S. Kaner befasst sich mit der Darstellung von Kleidung auf Keramikfigurinen aus der Jōmon-Kultur Japans. Die Rekonstruktion von Kleidung auf Grundlage dieser Funde spielt eine wichtige Rolle für die derzeitige Erforschung und die Verankerung der Jōmon-Kultur innerhalb des japanischen Kulturerbes.

Obwohl es sich beim vorliegenden Band nicht um eine systematische Auswertung aller verfügbaren Erkenntnisse oder eine umfassende Geschichte der Kleidung in der Steinzeit handelt, geben die hier zusammengetragenen Beiträge einen Überblick über den aktuellen Wissensstand, analytische Ansätze sowie mögliche zukünftige Forschungsrichtungen in diesem Bereich. Kleidung ist für viele Perioden der Steinzeit nach wie vor ein wenig erforschtes Thema. Wie die hier vorgelegte Übersicht zeigt, ist dies nur teilweise auf einen Mangel erhaltener Quellen zurückzuführen. Eine stärkere Konzentration auf Studien zu Gebrauchsspuren und Residuen in Kombination mit kontrollierten archäologischen Experimenten ist sicherlich ein Ansatz, um die spärlichen archäologischen Funde zu ergänzen und zum Sprechen zu bringen. Ein weiteres wichtiges Ergebnis der hier zusammengetragenen Beiträge und der Diskussionen während der Tagung war die Erkenntnis, wie stark archäologische Rekonstruktionen in Museen und Medien die öffentliche Wahrnehmung unserer Vorgeschichte prägen und beeinflussen. Darstellungen nackter oder spärlich bekleideter prähistorischer Menschen führen zu abwertenden Vorstellungen über die geistigen und sonstigen Fähigkeiten unserer Vorfahren. Es ist daher von großer Bedeutung, dass die Forschung zur prähistorischen Kleidung verstärkt in solche Rekonstruktionen einfließt: Dies ist ein weiteres Ziel des vorliegenden Bandes.

## Danksagungen

Unser herzlicher Dank gilt Claudia Gärtner, die uns bei der Organisation der Konferenz maßgeblich unterstützt hat und die mit ihrem Team von freundlichen (studierenden) freiwilligen Helfern stets zur Stelle war, um im Hintergrund für einen reibungslosen Ablauf zu sorgen. Sie ist nicht nur eine warmherzige Person, sondern auch intellektuell inspirierend. Wir möchten uns auch bei der Martin-Luther-Universität Halle-Wittenberg und dem Verein zur Förderung des Landesmuseums für Vorgeschichte Halle (Saale) für ihre Unterstützung bedanken. Unser besonderer Dank gilt Manuela Schwarz, Anne Gottstein, Birte Janzen, Florian Michel, Britta Stein, Rocco Steputat und Aniela Schuchardt für die organisatorische, redaktionelle und gestalterische Arbeit, die diesen Band ermöglicht hat, sowie Carola Murray-Seegert für das Korrekturlesen der englischen Texte und die Erstellung der erforderlichen Übersetzungen.

work that made this volume possible, and Carola Murray-Seegert for proofreading the English texts and writing the necessary translations.

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## Abbildungsnachweis/*Source of figures*

1 LDA
2 J. Lipták, München
3 umgezeichnet und verändert von O. Jöris aus/redrawn and modified by O. Jöris from Akhmetgaleeva u. a. 2024, Fig. 1,3.
4 J. Lipták, München
5 K. Schauer, Salzburg
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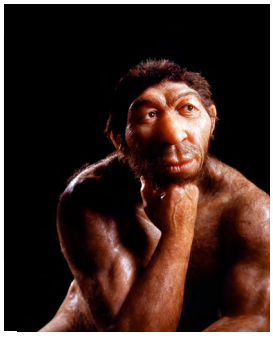
# SEKTION I: VON DER FIKTION ZUR WISSENSCHAFT UND ZURÜCK – KLEIDUNGSREKONSTRUKTIONEN UND WAHRNEHMUNG

# SECTION I: FROM FICTION TO SCIENCE AND BACK TO FICTION – CLOTHING RECONSTRUCTIONS AND PERCEPTION



»Der Denker« von Elisabeth Daynès ist in der Dauerausstellung des Landesmuseums für Vorgeschichte Halle (Saale) zu sehen (Foto: Juraj Lipták, München).

*»The Thinker« by Elisabeth Daynès can be seen in the permanent exhibition of the State Museum of Prehistory* Halle (Saale) (Photo: Juraj Lipták, Munich).

# Clothing or nakedness in reconstructions of prehistoric humans

Pauline Coste

**Zusammenfassung**

Bekleidung oder Nacktheit bei Rekonstruktionen von prähistorischen Menschen

*Menschen der Altsteinzeit werden häufig als Teil von Museumsausstellungen oder wissenschaftlichen Beiträgen rekonstruiert, vermehrt aber erst seit den 1990er Jahren. Diese Praxis existiert jedoch schon seit den Anfängen der Vorgeschichtsforschung und stützt sich stark auf die Fantasie der »Paläo-Künstler«, insbesondere wenn es um die Entscheidung geht, paläolithische Menschen entweder bekleidet oder nackt darzustellen.*

*Diese Studie basiert auf einer Untersuchung von ca. 1300 Rekonstruktionen von 143 dem Paläolithikum zugeordneten Individuen (Männer, Frauen und Kinder) aus der Zeit von vor 7 Mio. Jahren bis vor 10 000 Jahren vor heute. Die Beispiele stammen vornehmlich aus 132 Museen weltweit und umfassen den Zeitraum von 1875 bis heute. Darunter sind etwa 500 Ganzkörperdarstellungen. Diese Werke bieten die Gelegenheit, die Entscheidungsgrundlagen der ›Paläokünstler‹ und ihrer Auftraggeber in Bezug auf Nacktheit oder Kleidung zu diskutieren. Der vorliegende Bericht analysiert den Typ der Bekleidungsform (Nacktheit, Lendenschurz, Tunika, warme Kleidung) je nach Spezies (*Australopithecus, Homo erectus, Neandertaler, *usw.), sucht nach den archäologischen Elementen, die die Quelle dieser Wahl gewesen sein könnten, und versucht zu bestimmen, welche davon rein imaginär sind oder den jeweiligen Zeitgeist widerspiegeln.*

**Schlagwörter** Rekonstruktionen, Kleidung, 19. Jahrhundert, »Paläo-Künstler«, Museographie

**Summary**

*Palaeolithic people have often been reconstructed as part of museum displays or scientific contributions, especially since the 1990s. However, this practice has been around since the beginnings of the discipline of Prehistory and has included a large share of imagination, especially when it concerns the decision to display Palaeolithic peoples as either dressed or naked.*

*This study is based on a survey of c. 1300 reconstructions of 143 identified Palaeolithic individuals (men, women and children) dating from 7 mya to 10 kya, mainly from 132 museums around the world, represented in reconstructions that were made from 1875 to the present day. Of these, around 500 are full-body representations. These works provide an opportunity to discuss the choices made by ›palaeo-artists‹ and those who commissioned their work regarding nudity or clothing.*

*The present report analyses the proportion of clothing choices (nudity, loincloths, tunics, warm clothing) according to species (*Australopithecus, Homo erectus, Neanderthals, *etc.), searches for the archaeological elements that may have been the source of these choices, and attempts to determine which are purely imaginary or reflect* zeitgeist *biases.*

**Keywords** Reconstructions, clothes, 19th century, ›palaeo-artists‹, museography

## First images in publications

Historically, the earliest references to prehistoric humans are drawings published as illustrations for scientific articles. The earliest is *›L'homme fossile‹* by T. Sushemil to illustrate a text by P. Boitard in a French publication, *Musée des familles* (Boitard 1837, 209). It depicts a man with simian face and hairy body, standing alone near a cave and holding an axe, wearing a lion skin tied around his neck (Fig. 1).

According to an article by A. Leguebe (1986, 15), P. Boitard was aware of A. von Schmerling's discoveries of fossil human remains at Engis, Belgium, and of a few other discoveries. Long before anyone else, and decades before the Neanderthal type specimen was found near Düsseldorf, Germany, P. Boitard was also a spokesman for the acceptance of the existence of ›fossil man‹ (Leguebe 1986, 15).

This early image was followed many years later by another drawing of ›l'homme fossile‹, this time by Moreau, to open P. Boitard's book, published posthumously in 1861 (Fig. 2). The man – still at the edge of a cave – now protects his wife and child, who are hiding inside.

Very hairy, almost naked, clad in skimpy animal skins tied around their necks, these early human figures have a rather simian appearance even before Darwin's famous publications, and clearly combine the ›wild‹ men and women of medieval folklore, the mythological figure of Hercules, and the idea of primitiveness (Fig. 3–4).

Famous early images, still used to illustrate articles, include etchings created by E. Bayard for publications by L. Figuier (1870a; Figuier 1870b; Figuier 1882). In them, the appearance and clothing of *›l'homme primitif‹* changed with edition. The first edition, dating from the beginning of 1870

(Figuier 1870a), presents humans *(Homo sapiens)* of white European ›Aryan‹ appearance (as Figuier calls them), wearing skimpy tunics, while the second edition (1870b), presents them as ›Lapps‹ – shown not only by their faces but also their warmly sewn clothing because in the meantime, anthropological studies by M. Pruner-Bey had associated the freshly discovered fossil skulls at Solutré, Dép. Saône-et-Loire and Cro-Magnon, Dép. Dordogne, both France, with ›Mongoloids‹ (Roussot 2003). As L. Figuier (1870b, 104) writes: »In the scenes of human life during the era of the great bear and the mammoth, we have taken as our model the nowadays Lapp. This type will remain the same throughout the following period, i.e. during the reindeer era«. We can see that this purely morphological association is immediately followed by changes in clothing: it suddenly becomes much warmer and covering.

It should be noted that L. Figuier's book does not present any reconstructions of Neanderthals, even when there are etchings from the ›age of the great bear and the mammoth‹, as the Middle Palaeolithic was known at the time. All hominins depicted are presented as anatomically modern humans. According to A. Roussot (2003, 76), L. Figuier was clearly asserting his creationist point of view and neglecting any ideas of evolution. Today, the warm garments adapted to glacial climates seem much more accurate, but it's not those images that still appear. When they are reproduced, today's media mostly prefer those from the first edition (Figuier 1870a), which are more in line with our modern collective imagination.

At the end of the 19th century, many artists were inspired by prehistory, such as F. Cormon, P. Jamin, and L. M. Faivre (Dagen 2003). Some of their characters were depicted naked, some with loincloth or tunic, and a few well-covered by clothing.

## Museum displays

The first reconstructions in the form of busts or whole bodies (i.e. mannequins) arrived at the end of the 19th century, accompanying the first presentations of archaeological objects. They were found at the Paris World's Fairs (1889 and 1900) and in the first museums from 1876, as in Musée de l'Artillerie, Paris (Robert 1889, 10–13).

## Neanderthals (first reconstructions)

›Neanderthal man‹ was the first fossil man to be reconstructed from concrete archaeological remains. However, reconstructions did not begin until around 20 years after the discoveries made in 1856 at Kleine Feldhofer Grotte (Neandertal, Mettman Disctrict, Germany) and the recognition of the finds as a possible fossil representative of the human lineage.

An early etching, dated to 1873, shows a male Neanderthal, wearing a skin tunic and accompanied by two dogs, while inside a cave, a female sleeps under blankets. Turn-

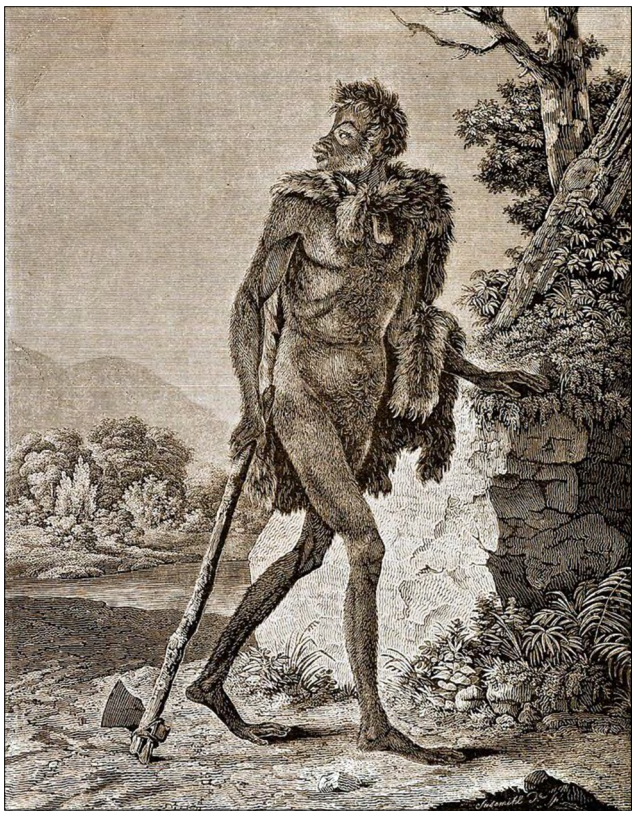


**Fig. 1** ›*L'homme fossile*‹ by T. Sushemil for P. Boitard in *Magasin Universel* 1838.

***Abb. 1*** ›L'homme fossile‹ *von T. Sushemil für P. Boitard im* Magasin Universel *1838.*

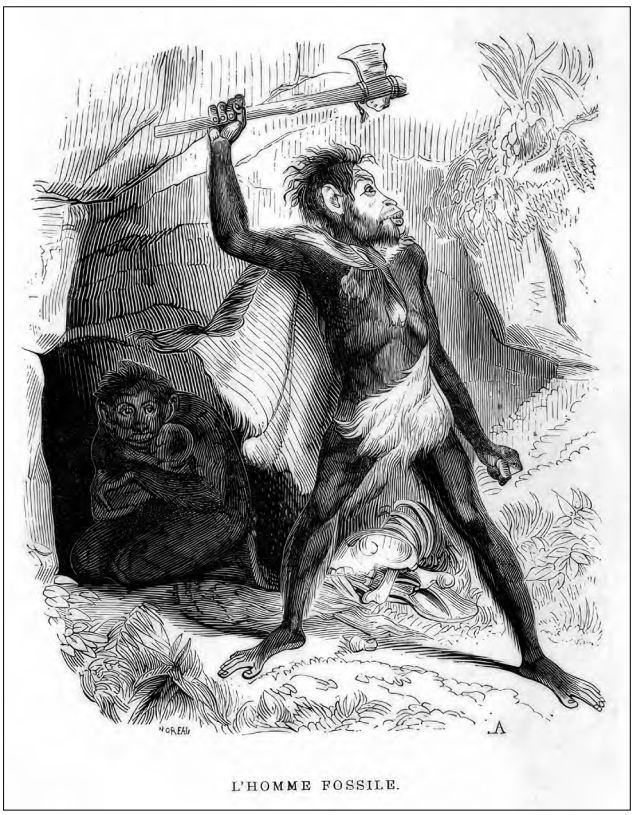



**Fig. 2** ›*L'homme fossile*‹ by Moreau for P. Boitard's postumous book, *Paris avant les hommes* 1861.

***Abb. 2*** ›L'homme fossile‹ *von Moreau für P. Boitards postum erschienenes Buch,* Paris avant les hommes *1861.*

**Fig. 3** J. Bourdichon, *›The Wild Condition‹* from *Four Conditions of Society.* Circa 1505–1510. Tempera on vellum. 16 x 12 cm.

***Abb. 3*** *J. Bourdichon, ›Der wilde Zustand‹ aus* Vier Zustände der Gesellschaft. *Circa 1505–1510. Tempera auf Pergament. 16 x 12 cm.*

**Fig. 4** *›Hercules and Cacus‹* by H. Goltzius, 1613.

***Abb. 4*** ›Herkules und Cacus‹ *von H. Goltzius, 1613.*

ing towards the entrance, the man holds a fitted stone axe (Holyoke 1993). It was first published in Harper's Weekly (Moser 1998). A few years later, F. Cushing (working for J. P. Maclean, 1875/1877 or 1880) and H. Schaaffhausen (1888) first tried to depict the individual's face in drawings (Giacobini/Maureille 2009, 35; Semal et al. 2010; Lambers et al. 2022, 35).

The first sculpted bust of a Neanderthal (Fig. 5). was made in the 1880s by G. Mitchell (Lambers et al. 2022, 35). Nude and black, he has a beard that merges with his chest hair and descends in a vertical band down the torso, suggesting that the individual is naked; it closely resembles F. Cushing's drawing.

In terms of whole-body reconstructions, it seems that the first were exhibited at the *Musée de l'Artillerie* (Paris, France) around 1876 (Fig. 6, right), followed by those in the diorama at the 1889 Paris World's Fair (Fig. 7).

While the Neanderthal[1] of the *Musée de l'Artillerie* is warmly dressed, those at the 1889 World's Fair are virtually naked. In both cases, they are highly humanised and in no way simian. Those at the World's Fair are a man and a woman, both positioned close to the ground; he is sitting on the ground while she is kneeling. She is wearing a loincloth, a sort of cape (although it does not cover her breasts[2]), and a hairband. He wears a fur-lined loincloth. The official exhibition catalogue describes them as follows (Catalogue Exposition universelle internationale Paris 1889, 120):

›The first industrialists – A flintknapping workshop (Mammoth Age)‹. At the foot of a hollow tree, which may provide them with an asylum, a man and a woman chip and carve flint, to make their first weapons and tools. The scene was inspired by a drawing by T. Baines (San Augustin-Filaretos 2003, 54–56), depicting modern-day Aboriginal Australians performing the same industrial operations. The Aboriginal Australians of Queensland and Western Australia are indeed the best characterised of the Palaeolithic industry it was intended to portray.

It seems that at the time (viewed through a racist and colonialist prism), Aboriginal Australians were considered to be at the ›same stage‹ of evolution as Neanderthals (Cohen 1999).

1 A drawing inspired by the mannequin of the Musée de l'Artillerie is presented as ›Mousterian man‹ in H.-R. Du Cleziou's book (1887, 204), but at that time this industry has not yet been associated with Neanderthal. This link will be established in later in 1887 with the publication of the discoveries at Spy, Province of Namur, in Belgium (Giacobini/Maureille 2009, 35).

2 The breasts of prehistoric women, especially Neanderthals, are almost always shown exposed, even until today.

**Fig. 5** ›Ideal reconstruction‹ based on the Neanderthal skull by Ward/Mitchell, 1880s.

***Abb. 5*** *›Ideale Rekonstruktion‹ basierend auf dem Neandertaler-Schädel von Ward/Mitchell, 1880er Jahre.*

**Fig. 6** Warrior Costumes. Prehistoric ages. Left: La Madeleine type *(Homo sapiens)*; right: Moustier Type (Neanderthal). Paris, *Hôtel des Invalides, Musée de l'Artillerie*. Postcard, 1876.

***Abb. 6*** *Kriegerrekonstruktionen. Prähistorische Zeitalter. Links: La Madeleine-Typ* (Homo sapiens)*; rechts: Moustier-Typ (Neandertaler). Paris,* Hôtel des Invalides, Musée de l'Artillerie. *Postkarte, 1876.*

The short description of the diorama was followed by a list of sites and remains used as sources for the reconstruction: Spy, La Naulette, Province of Namur, Belgium, and Gourdan, Dép. Haute-Garonne (France; the Neanderthal skull from The Kleine Feldhofer Grotte is not mentioned). The authors of the catalogue added that soft parts were reconstructed from ›atavistic types‹ around Paris and Belgium (!). »The axe is from Western Australia. The costume elements are borrowed from various modern-day wild peoples« (Catalogue Exposition universelle internationale Paris 1889, 120).

In 1908, following the famous discovery of a complete Neanderthal skeleton, M. Boule's description and study of the La Chapelle-aux-Saints Man was to leave its mark. This led to a return to frankly simian and highly aggressive representations, such as F. Kupka's famous drawing (Cohen 2007, 36–37)[3] – nude and very hairy, or N. Montecucco's 1909 bust for C. Lombroso, which bares his teeth[4] (Cohen 2007, 46–47; Giacobini/Maureille 2009, 39). However, these representations of Neanderthals with high levels of simian hair were to remain very rare.

These images strongly contrast with a drawing by A. Forestier for A. Keith, produced in 1911 (i.e. at almost the same time) for the front page of the *Illustrated London News* (Cohen 2007, 38–39; Giacobini/Maureille 2009, 38). This image also showed the man from La Chapelle-aux-Saints, Dép. Corrèze (France), wearing a skin loincloth, but appearing calm, simply knapping flint. An attached text says (on the front page of the magazine), »Not in the gorilla stage«, emphasising the opposition of A. Keith to M. Boule's opin-

3 Produced in 1909 for the magazine *L'illustration* and the *Illustrated London News*. This image is often used today to illustrate how much better reconstructions are done today than in the past.

4 At the same time, A. Rutot's Neanderthal woman from La Quina, Dép. Charente (France), and that of H. Martin, are also very much in the simian style. H. Martin (1913, 86) writes in justification: »The eyes, nose and ears, having left no palpable traces, have been executed under the inspiration of the broad lines observed on the Chimpanzee; I consider that this is a right, for this anthropoid, in offering us in its skeleton certain incontestable similarities with the Neanderthals, can and must have other similar organs«.

**Fig. 7** Diorama. Reconstructions of Neanderthals (man and woman). World's Fair, Paris 1889.

***Abb. 7*** *Diorama. Neanderthalerrekonstruktionen (Mann und Frau). Weltausstellung, Paris 1889.*

ion. Two theories then exist: either Neanderthals were our ancestors and were depicted in a very humanised fashion, or they represented an extinct evolutionary branch. In the latter case, they were dumbed down and bestialised. Since 2010, when Neanderthals were linked to our ancestors by aDNA (Green et al. 2010 quoted by Frayer 2019, 357), representations have once again become more sympathetic (Frayer 2019).

In the first half of the 20th century, the question of whether Neanderthal hair was simian or not became less a topic of debate (per. obs., P. Coste) as representatives of older hominin species were discovered, such as Java Man, East Java, Indonesia, the australopithecine child from Taung, North West Province, South Africa, the Peking Man, the »faked« Piltdown man, and the *Homo rhodensis*.

In 1920, the artist C. Knight created two large paintings for the American Museum of Natural History in New York. The first painting depicted a group of Neanderthals at Le Moustier, Dép. Dordogne (France), while the other showed a group of Cro-Magnons painting the cave of Font de Gaume, Dép. Dordogne (France). Unsure about the question of clothing, C. Knight consulted H. Breuil, the most famous prehistorian of the time, who told him to illustrate them naked. In the end, however, to respect the public's modesty and on the advice of his boss, R. Osborn, C. Knight opted for skin loincloths (Clary 2022).

In 1928, a diorama was prepared by F. Blaschke for the Field Museum of Chicago (Fig. 8a). According to the museum catalogue published shortly afterwards (Farrington/Field 1929), the reference individuals had been the man from La Chapelle-aux-Saints for the older adult male, the skull from Forbes' Quarry, British Overseas Territory of Gibraltar, United Kingdom, south of the Iberian Peninsula, for the two women, and that from Devil's Tower, British Overseas Territory of Gibraltar, United Kingdom, south of the Iberian Peninsula, for the adolescent. Those were the

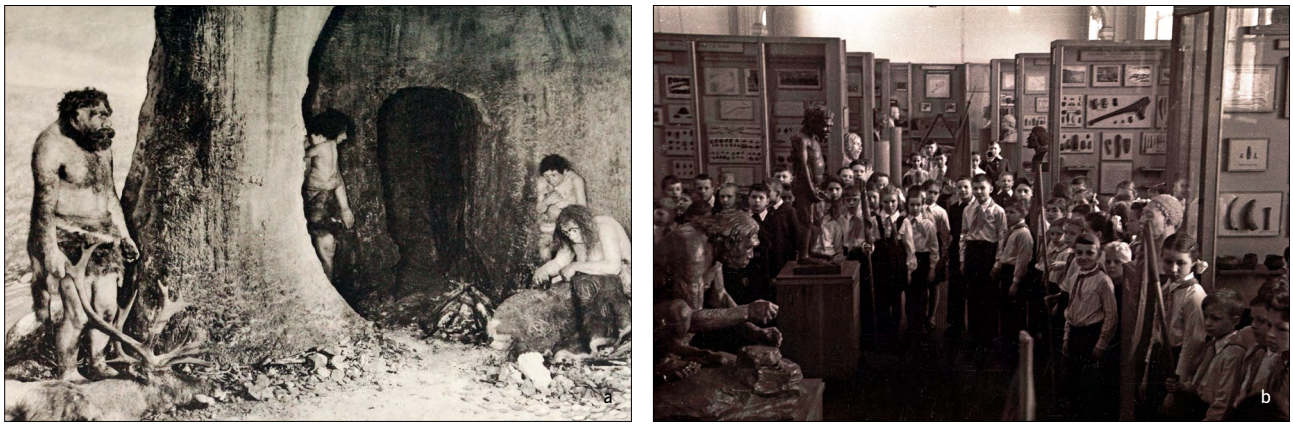



**Fig. 8a–b** a Reconstruction of a Neanderthal family. Group by F. Blaschke in the Ernest E. Graham Hall, Field Museum of Natural History, Chicago, USA (1929); b Pioneer lineup at the exposition on the origin of man (Leningrad 1959). Sculptures by M. M. Gerasimov. In the middle: the figure of the Neanderthal boy from Teshik-Tesh Cave (1945).

***Abb. 8a–b*** *a Rekonstruktion einer Neandertalerfamilie. Gruppe von F. Blaschke in der E. E. Graham Hall, Field Museum of Natural History, Chicago, USA (1929); b Erstaufstellung auf der Ausstellung über den Ursprung des Menschen (Leningrad 1959). Skulpturen von M. M. Gerasimov. In der Mitte: die Figur des Neandertaler-Jungen aus der Teshik-Tasch-Höhle (1945).*

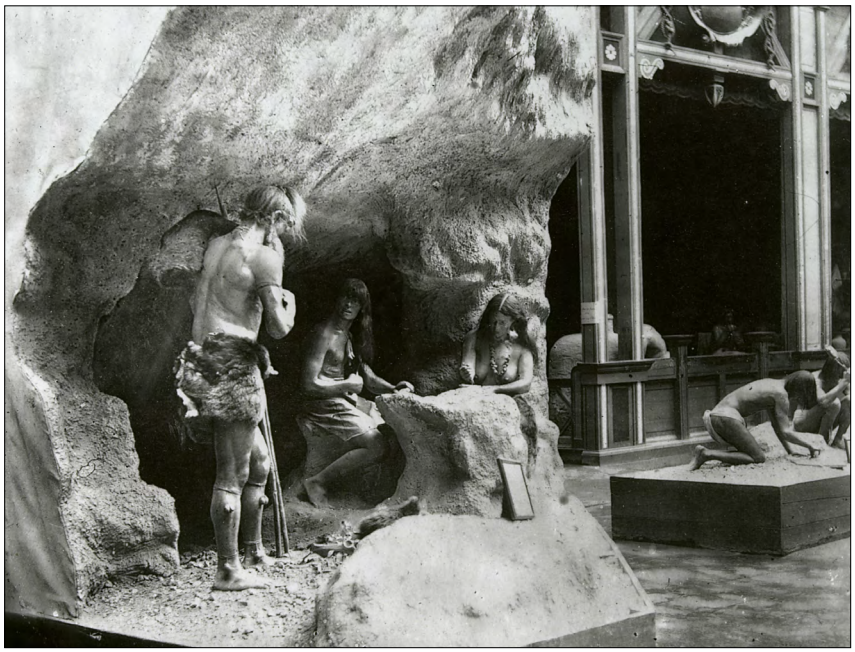


**Fig. 9** Diorama. Laugerie-Basse rock shelter (Vézère Valley, Dép. Dordogne [France]), with group of Cro-Magnons (Cro-Magnon 1, ›the old man‹, standing facing a young man and a woman). World's Fair, Paris 1889.

***Abb. 9*** *Diorama. Laugerie-Basse Felsdach (Vézère-Tal, Dép. Dordogne [Frankreich]), mit einer Gruppe von Cro-Magnons (Cro-Magnon 1, ›der alte Mann‹, stehend gegenüber einem jungen Mann und einer Frau). Weltausstellung, Paris 1889.*

best-preserved skulls and complete skeletons known at the time. The diorama was supposed to evoke a scene at the site of Le Moustier, it was inspired by a field trip and information-gathering session with the great specialists of the time: A. Keith (who had supervised the reconstruction of the skull from Forbes' Quarry), and H. Breuil. It's possible that the baby shown in the diorama referred to the 1914 discovery of a baby (Moustier 2) at the same site, but the catalogue does not mention this. Surprisingly, the teenager is not based on finds at the Le Moustier site (Moustier 1). All individuals are shown almost naked, wearing simple fur loincloths tied around the waist (except for the baby, who is completely naked). The adults have extensive, human-type hair. The man stands, appearing to be in a daze. The two women stare into space; one stands, holding the baby, and the other crouches, tanning a skin[5]. The teenager is standing and chewing some meat. As in the description of M. Boule, they are all depicted without necks – an interpretation later refuted by C. Arambourg: the old man analysed by M. Boule had neck problems, but not all Neanderthals did (Y. Coppens in the preface of Albarello 1987, 11)!

The Field Museum catalogue states: »Unfortunately for the completion of the restorations there are no data from which information as to the type, quality, and quantity of the hairy covering of the heads and bodies of people of this race could be obtained. In as much, however, as the primitive men of Australia have several Neanderthaloid characteristics, including heavy brow ridges, it was decided to follow their hirsute type« (Farrington/Field 1929, 7).

Once again, an association is made with Aboriginal Australians. It's also contradictory to see the figures so scantily clad when mention is made of an Ice Age site on the following page: it is as if there were no causal links between the two pieces of information. This is all the more puzzling since the flints had been analysed: they were known to have been used for »skinning and preparing hides« (Farrington/Field 1929, 11). Here again, these facts and data were not associated.

In the 1930s and 1940s, full bodies and busts of Neanderthals were reconstructed in France (e.g., the man of Le Moustier by Y. Parvillier and M. Faure for the National Prehistory Museum of Les Eyzies in France), while in Austria, F. Fahrwickl proposed a full-body reconstruction of the man from La Chapelle-aux-Saints for the National History Museum of Vienna (Lambers et al. 2022, 53). All these Neanderthal individuals are shown naked, some with large amounts of body hair.

In Russia from the 1940s to the 1960s, M. M. Gerasimov left his mark on the world of reconstruction. As L. Verzé explained: »[M. M. Gerasimov] first had to create a routine or system for quantifying those parts of the skull where the overlying tissue is thinnest and would be most invariant and reproducible. He then had to develop a way to determine the muscular structure of an individual head. Gerasimov thus created what was referred to as the Russian method« (Verzé 2009). He produced many forensic reconstructions as busts and drawings, but few full-body models; one exception was the Teshik-Tesh, Surxondaryo Region, Uzbekistan, Neanderthal child, cast in bronze and represented entirely naked (Fig. 8b).

Other Neanderthals were also reconstructed in Germany in the 1960s or earlier, probably by G. Wandel in 1962 in Bonn; these full-body figures wore a simple loincloth (Giacobini/Maureille 2009)[6]. From the 1950s but mainly spread in the 1980s, the most famous images of Neanderthals were painted by Z. Burian (Cohen 2007, 50–51; 61–68, Giacobini/Maureille 2009, 41–42)[7]; they invaded school textbooks and scientific works around the world, leaving their mark on the

5 Another constant in reconstructions is that Neanderthal women are almost always shown tanning hides.

6 G. Wandel's Neanderthals sculptures are now in Monrepos Museum, Germany.

7 More information about Z. Burian's work: <https://www.daildeli.cz/burianmak5.html> (10.06.2025).

collective imagination for a long time to come. There was no real change in physical appearance: the Neanderthal is stocky, with marked but human hair, hunched over and without a neck (as in M. Boule's description), and dressed in a loincloth. A certain constancy has become established in unchallenged reconstructions.

### *Homo sapiens* (first reconstructions)

The first reconstructions of complete mannequins of Palaeolithic *Homo sapiens* in dioramas are probably those from the *Musée de l'Artillerie* (well clothed, circa 1880; cf. Fig. 6) and those from the 1889 Paris World's Fair (Fig. 9).

The latter diorama shows three individuals in a rock shelter, identified as the Laugerie-Basse in the Vézère Valley, Dép. Dordogne (France; Catalogue Exposition universelle internationale Paris 1889, 120–121). An elderly man (probably individual Cro-Magnon 1) stands, talking to a woman (probably Cro-Magnon 2) and a young man (either Cro-Magnon 3 or Laugerie-Basse 4). The woman and the young man are wearing ornaments similar to those found at the Cro-Magnon shelter in 1868 (*Littorina littorea* and ivory pendants), while the standing man's ornaments are those of Laugerie-Basse 4 (most known as ›L'homme écrasé‹) *(Cypraea)* worn in duplicate on the ankles, wrists, knees and on either side of the forehead (Girod/Massenat 1900; Groenen 1997). The figures are all almost naked, clad in simple fur loincloths rolled into waist-length skirts. The standing man's *›houppe‹* (tuft of hair) hairstyle is inspired by an engraving found at Laugerie-Basse, showing a ›Man hunting aurochs‹[8] (Fig. 10; Girod/Massenat 1900, 97; Pl. XI). This astonishing hairstyle was later reproduced on a gilded plaster bust of Cro-Magnon 1 in the *Musée de l'Homme*, dated approximately 1891, as part of a series of four heads in the Hamy collection, including the Neanderthal type specimen (now called ›Kleine Feldhofer Grotte‹, found in the Neandertal), and Furfooz 1 and 2, Province of Namur, Belgium (Lafont-Couturier 2003, 48–49). The close similarity in date and the resemblance between these busts and the mannequins in the World's Fair dioramas suggest they were created by the same artist.

The 1889 exhibition catalogue explains the *Homo sapiens* diorama as follows: ›The three figures are reconstructed using almost complete skeletons found in rock shelters in the region, Laugerie-Basse, Cro-Magnon etc., thanks to which we were able to fix the proportions of the body, the essential shapes of the skull and face. The soft parts are based on several individuals of similar race, and in particular on heads moulded from Berbers, of the Cro-Magnon type‹. Concerning the clothing, the author adds: »The skin garments are purely conventional (we know nothing of the costume of these troglodytes from the south of France); but we have not hesitated to reduce them considerably and to represent almost naked men who must have lived exactly like the redskin hunters of the Upper North America that travellers represent to us as such« (Catalogue Exposition universelle internationale Paris 1889, 120–121).

**Fig. 10** ›Hunting auroch‹ from Laugerie-Basse rock shelter (Dép. Dordogne [France]). From Girod/Massenat 1900. On the right: detail of human representation: a man with a *›houppe‹* hair style, who inspired the hair style of 1889's Cro-Magnon 1 in the World Fair's diorama. O. M.

***Abb. 10*** *›Jagd auf einen Auerochsen‹ aus dem Felsenhaus von Laugerie-Basse (Dép. Dordogne [Frankreich]). Aus Girod/Massenat 1900. Rechts: Detail der menschlichen Darstellung: ein Mann mit einer* ›Houppe‹*-Frisur, die die Frisur des Cro-Magnon 1 von 1889 im Diorama der Weltausstellung inspirierte. No scale.*

Later, around 1890, Cro-Magnon 1 was reconstructed in sculpture by P. Richer titled *›Le premier artiste‹* (Dagen 2003, 43). It shows the shells found on the skull as a headband and the hair held in a bun by a bone pin. The individual is smiling, naked, and has just finished a mammoth sculpture.

Sculptures of *Homo sapiens,* based on specific remains and reconstructed as whole bodies, were quite rare before the 1980s/1990s. Strictly speaking, reconstructions representing a specific individual were, for a long time, mainly based on the remains of Cro-Magnon 1, Chancelade or Combe Capelle, all Dép. Dordogne (France; all men), and very often, only busts or heads were involved. Later, in the 1960s–1970s, Z. Burian sometimes depicted *Homo sapiens* in loincloths and tunics and warmly covered at other times.

8 Probably a bison (collection Musée d'Archéologie Nationale Saint-Germain-en-Laye, No. 53819).

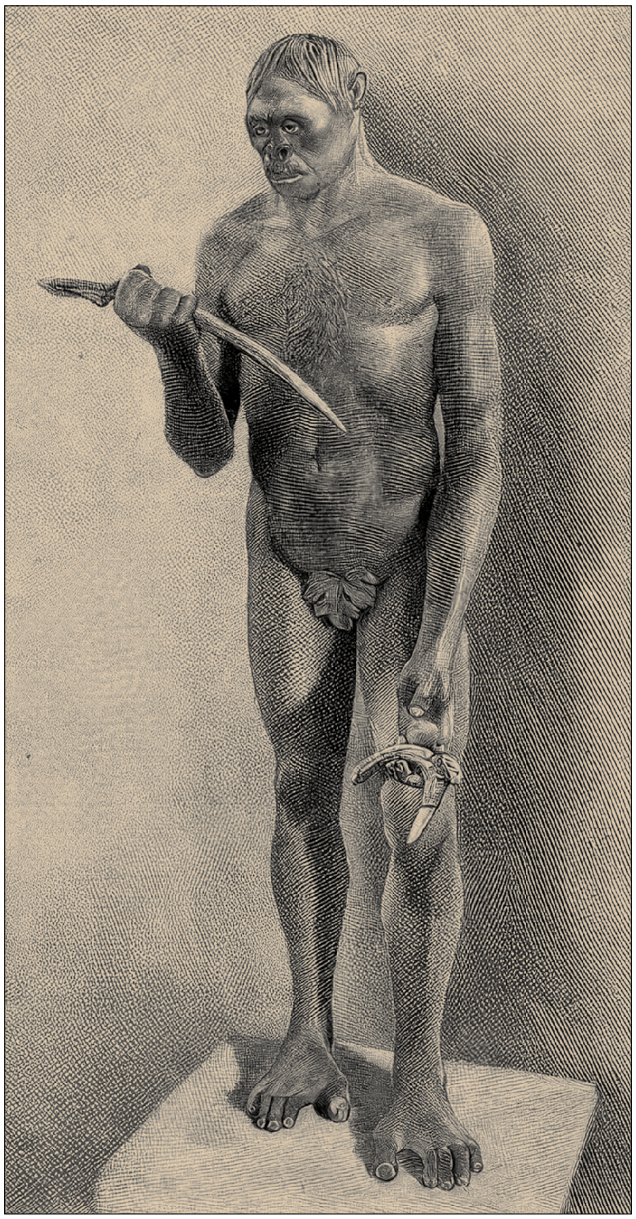


**Fig. 11** Reconstruction of the *Pithecanthropus erectus* (›man-monkey‹) presented at the Paris World Exhibition in 1900 by E. Dubois.

***Abb. 11*** *Rekonstruktion des* Pithecanthropus erectus *(›Menschenaffe‹), der 1900 von E. Dubois auf der Pariser Weltausstellung präsentiert wurde.*

## *Homo erectus* and *Homo heidelbergensis* (first reconstructions)

At the turn of the 20th century, the species now dated at around 500 kya were the oldest known: *Homo erectus* (at that time called *Paranthropus erectus*) discovered in Java by E. Dubois in 1891 (Jelinek 1983, 73), then the Heidelberg Man found at Mauer in 1907, Rhein-Neckar District, near Heidelberg in Germany (Jelinek 1983, 82). They were soon overtaken in notoriety by the Piltdown Man, ›discovered‹ in 1912 in East Sussex County, United Kingdom (i.e. in Europe – an advantage for European-centrism), which was claimed to be ›the oldest‹ at the time. The Piltdown Man was only unmasked as a fake in the 1950s with the help of the first $^{14}C$ dates, but in the meantime, he had become a household name (De Beaune/Balzeau 2009, 12). In the 1920s, the remains of the Peking Man (then known as *Sinanthropus pekinensis*, now called *Homo erectus*) from the Lower Cave at Zhoukoudian, China (Schwartz/Tattersall 2003; Jelinek 1983, 79), *Homo rhodensis* (sometimes called *Homo heidelbergensis* today) after a discovery at Broken Hills, Rhodesia (now Zambia), today named ›Kabwe‹, and the australophithecine child from Taung, Gauteng Province, South Africa, became the stars of their time. To this day, they are the subject of numerous reconstructions. The Peking man was often portrayed as a woman at that time (e.g. L. Swan's bust in 1937).

The first *Homo erectus* to be reconstructed with its entire body was the Java Man, recreated for the 1900 Paris World's Fair (Fig. 11). His reconstruction is based on a skull cap, a femur and a few other bones. The individual is shown naked, hairless, with opposable toes, and holding a stick. It is preceded by a ›theoretical‹ *Pithecanthropus allalus* (›mute‹, i.e. without associated remains). A male and female, both naked and very hairy, were painted by G. von Max in 1894. This theoretical ›missing link‹ between men and apes was propagated by E. Haeckel, who gave E. Dubois the idea of going to Java to search for it. A few years later, in their series of 15 busts (half body) of human evolution produced between 1909 and 1914, the French sculptor L. Mascré and archaeologist A. Rutot (Hauzeur/Mairesse 2003, 116) presented, in addition to Neanderthal and *Homo sapiens*, busts of the Java Man, the Piltdown Man, and also the Mauer Man (the *Homo heidelbergensis* type specimen of which only a mandible had been found). Their ›precursor‹ (the Java Man) is depicted as very simian (Hauzeur/Mairesse 2003, 111; Leguebe 1992) and clad in tree leaves, while the others, with the exception of Neanderthal Man who wears a fur tunic strap, and *Homo sapiens*, the ancient species are shown naked, the lower torso covered with a skin resembling a fur or blanket.

## Today

The 1990s and 2000s saw the return and increase of mannequins in museography. It is fair to say that since 2000–2010, reconstructed images have proliferated to the point of invading magazine covers and becoming an almost obligatory part of recent museography. These individuals mostly represent archaic hominins, followed closely by Neanderthals, while *Homo sapiens* is less frequently reconstructed and featured less prominently in the press, or if so, only in the form of old images.

## First hominins (7–2 mya)

To date, for the period between 7 and 2 mya ago, the individuals shown in their entirety (92 reconstructions for 13 individuals) are always presented naked (100 %; Fig. 12–13), with varying degrees of simian hair, whatever the species: Toumaï *(Sahelanthropus tchadensis)*, *Orrorin tugensis, Ardipithecus (ramidus)*, various australopithecines *(A. africanus, A. afarensis, A. sediba, A. garhi, A. bahelghazali)*, and *Parenthropus.*

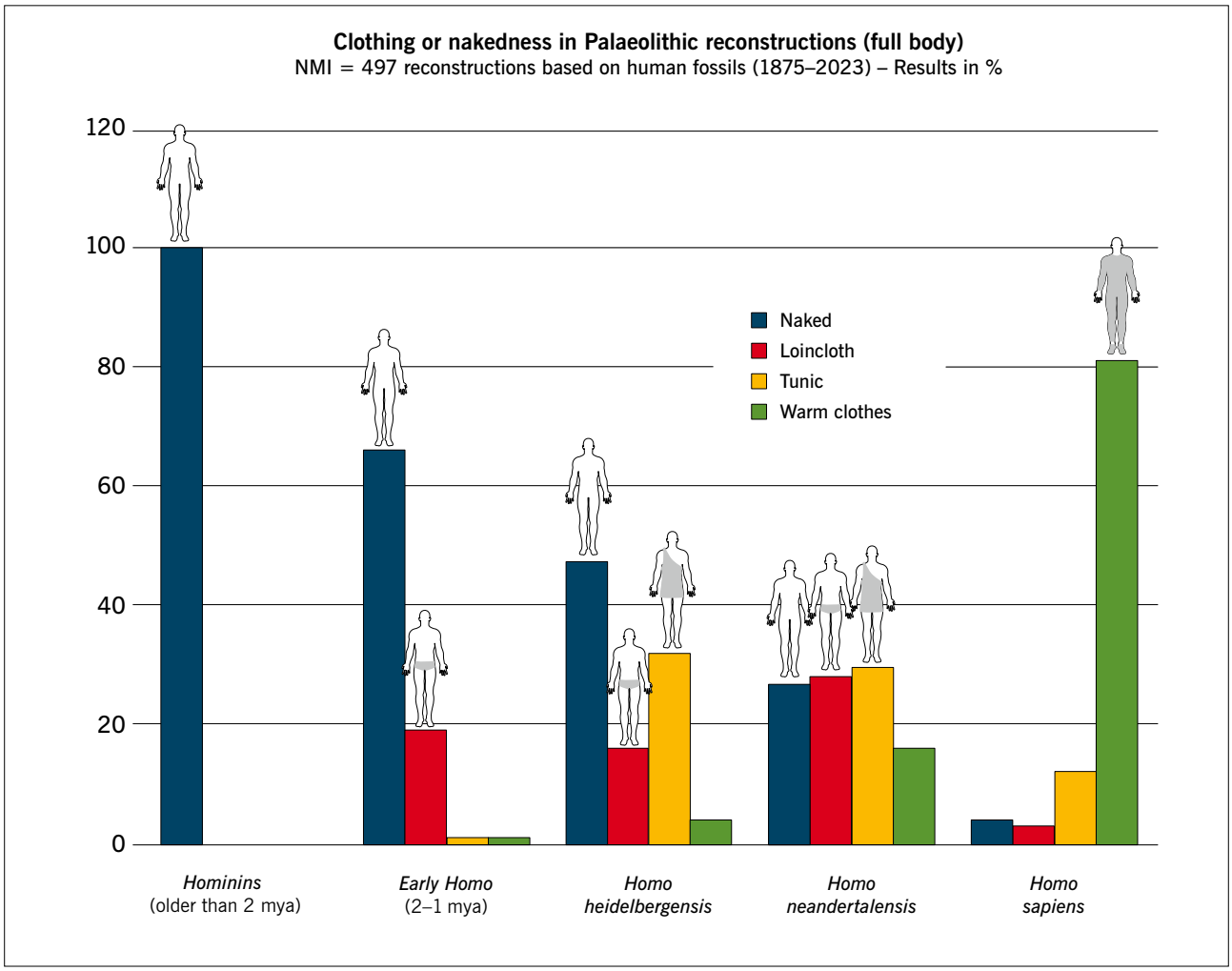



**Fig. 12** Degree of clothing or nakedness in reconstructions depending on species.

***Abb. 12*** *Grad der Bekleidung oder Nacktheit bei Rekonstruktionen je nach Art.*

According to the present research, Lucy's body[9] is by far the most frequently reconstructed since its discovery in 1972 (especially from the 1990s onwards). She is very often shown with a taller male australopithecine, nicknamed Lucien or Lucky (reconstructed according to skull AL444-2). It must be said that, for these early periods, this is the most complete skeleton. Lucy and Lucien are frequently shown walking in ashes, suggesting the footprints found in Laetoli, Tanzania, a site of similar age, which was also discovered in the 1970s and has also become famous.

The Taung child and Mrs. Ples, Gauteng Province, South Africa (both fossils classified as *Australopithecus africanus*) are also often reconstructed, and always naked. Mrs. Ples has largely been upstaged by Lucy, but the Taung Child is still frequently reconstructed.

Before more discoveries, the absence of skin or hide-working use-wear on lithic tools and, above all, the tropical climate in which these individuals lived make the nudity of these periods credible.

## Early Palaeolithic (2 mya–500 kya)

For the Early Palaeolithic, we can distinguish different choices in terms of clothing, with a very large majority of individuals shown naked. In all, out of 69 Early Palaeolithic reconstructions of all hominin species *(Homo habilis, H. erectus, H. georgicus, H. ergaster, H. antecessor)*, 63 % are nude (n = 44), 18 % wear a loincloth (n = 13), extremely marginally, less than 3 % are presented with warm clothing (n = 2), and only a single specimen has a warm tunic-type garment.

There is also a wide variety of hair types in reconstructions from this period. While not always simian-like, hair is sometimes very pronounced and other times completely absent. While the Turkana Boy, *Homo ergaster*, now dated at 1.47 mya (McDougall et al. 2012), is always presented as hairless, Sangiran 17 (~ 0.7 mya) *Homo erectus* is often very hairy, while for *Homo georgicus* of Dmanisi (1.8 mya) there is great variability in terms of hairiness in reconstructions.

9 »Lucy« is an *Australopithecus afarensis*, also known as AL288-1, and her reconstruction is often associated with another remain, AL417-1, as AL288-1 is virtually lacking a skull.

**Fig. 13** Jeongok Prehistory Museum, South Korea, 2011. Full body hyper realistic reconstructions by E. Daynès. Leading the group: Toumaï *(Sahelanthropus tchadensis)* 7 mya, followed by Lucy and Lucien *(Australopithecus afarensis)* around 3,5 mya. The corresponding skulls are presented below.

***Abb. 13*** *Vorgeschichtsmuseum Jeongok, Südkorea. Hyperrealistische Ganzkörper-Rekonstruktionen von E. Daynès. Führend in der Gruppe: Toumaï* (Sahelanthropus tchadensis) *vor 7 Mio. Jahren, gefolgt von Lucy und Lucien* (Australopithecus afarensis) *um 3,5 Mio Jahre. Die entsprechenden Schädel werden im Folgenden vorgestellt.*

Today, most reconstructions put this ›hair frontier‹ somewhat arbitrarily between 1 and 2 mya. Before 2 mya, individuals are always shown naked, often with simian hair. After 1 mya, ›human-like hair‹ (rather hairless) is in the majority.

### *Homo heidelbergensis*

For palaeo-artists, the problem of body hair and clothing becomes more complicated after 500 kya, starting with *Homo heidelbergensis* and continuing with Neanderthals.

43 % of reconstructed *Homo heidelbergensis* are shown naked (23/49), although clothing is beginning to appear in reconstructions, especially tunics (n = 16) and, more rarely, warm clothing (n = 2).

Apparently with no specific reason (except maybe a ›more human‹ morphology?), *Homo heildelbergensis, Homo antecessor,* the Neanderthals and *Homo sapiens* are shown without simian hair. Meanwhile, for their later contemporaries such as Flores and Naledi, the choice of hair varies, and they are almost always shown naked (more *›Homo erectus*-like‹?).

It seems that actual evidence of hide working might have begun around the MIS 12/13 transition, some 450 kya ago, as indicated by use-wear studies[10]. Given the cold periods these populations lived through, why imagine them naked, like Arago 21 (found in Tautavel in 1971, Dép. Pyrénées Orientales (France), -450 kya) reconstructed by E. Daynès for the Forschungsmuseum, Schöningen, Germany or Petralona (found in Greece, in 1960) reconstructed by E. Daynès in 2003 for Landesmuseum für Vorgeschichte Halle, Germany; Fig. 14), or also Altamura, (found in Apulia, Italy in 1993) reconstructed by the Kennis brothers in 2017 for a local museum in Italy?

Earlier reconstructions of Arago 21 are dressed in a simple goatskin tunic as in the Tautavel Museum diorama by E. Daynès in 1992, but is it more accurate? From this time

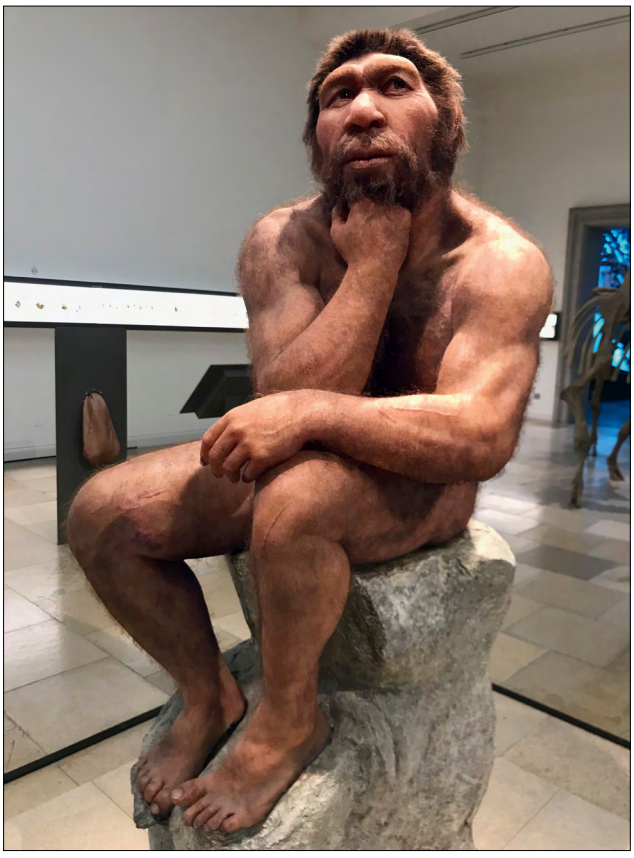


**Fig. 14** Reconstruction of a *Homo heidelbergensis* or Neanderthal by E. Daynès from Petralona skull. State Museum of Prehistory, Halle (Germany).

***Abb. 14*** *Rekonstruktion eines* Homo heidelbergensis *oder Neandertaler von E. Daynès auf der Grundlage eines Schädels aus Petralona. Landesmuseum für Vorgeschichte Halle (Deutschland).*

10 Zupancich et al. 2015; Lemorini et al. 2020; Nicoud et al. 2022; Verheijen et al. 2023.

**Fig. 15** Diorama of a group of Neanderthals: a man with a spear standing next to a young woman chewing a fur and an old woman sitting next to her. It is intended to recreate the site of Le Moustier, Dép. Dordogne (France). American Museum of Natural History, New York (USA) in 1993.

***Abb. 15*** *Diorama einer Neandertaler Gruppe: ein Mann mit einem Speer, der neben einer jungen Frau steht, die ein Fell kaut, und eine alte Frau, die neben ihr sitzt. Es soll den Fundort Le Moustier, Dép. Dordogne (Frankreich), nachstellen. Amerikanisches Museum für Naturgeschichte, New York (USA) 1993.*

onwards, evidence of hide-working and fur exploitation has been accumulating at various sites. Is this the starting point of the first potential garments? It seems that we need to start asking the question from this period onwards; the diversity of artists' proposals is a good marker for the fact that science does not yet have a precise answer to the question of clothing or nakedness for people of that time.

## Neanderthals (~ 250–40 kya) in present-day reconstructions

For Neanderthals, if we consider the entire period (1875–2024), we find almost equal numbers of all variants (nude 30 %, loincloth 31 %, tunic 33 %, warm clothing 18 %), with fewer individuals in the latter category.

The most well-covered individuals were made in the 1990s (W. Shnaubelt and N. Kieser for German museums[11], such as the Rheinisches Landesmuseum Bonn and the LVR-LandesMuseum Bonn and E. Daynès for the Neanderthal Museum in Mettmann, Germany), or recently F. Fogliazza in 2010 for the Museo de la Evolución Humana in Burgos, Spain; O. Nielsson for the Brighton Museum, United Kingdom, but in all cases, the well-covered reconstructions are quite rare compared to the others.

In the 1990s also, several dioramas were created for the American Museum of Natural History (AMNH) in New York. The Neanderthal diorama at AMNH was created by C. Leone under the supervision of I. Tattersall and G. Sawyer (Tattersall 1992). It includes a standing man and two seated women; one is elderly and wears a fur cape, and the other chews on a skin. The naked man is holding a pointed stick. Here again, as in the T. Sushemil reconstruction of 1838 (cf. Fig. 1) or F. Blaschke's diorama of 1929 for Chicago's Field Museum, we find the idea of a man standing – returning or going hunting – and women seated in the cave, involved in domestic activities around a hearth. The position of the individuals reinforces the idea of male domination. Regarding the clothing, the figures are less covered than those in F. Blaschke's diorama, who wear loincloths (cf. Fig. 8a); in contrast, the individuals shown in the AMNH 1990s diorama are naked or almost naked (Fig. 15).

To justify the figures' nakedness, even though hide scraping was known, I. Tattersall explained: ›The first major shock always came with the addition of hair to a formerly glabrous head – an old friend was suddenly transformed into a stranger. Draping the naked figures with animal hides that obscured the results of hundreds of hours of laborious body detailing was equally jarring for us. Predictably,

11 About W. Schnaubelt and N. Kieser (Wild Life Art): their busts of human evolution are in Hessisches Landesmuseum, Darmstadt, Germany and Naturhistorisches Museum Basel, Switzerland.

**Fig 16** Diorama of Neanderthals by E. Daynès. Krapina Cave, Krapina-Zagorje County (Croatia), 2010.

***Abb. 16*** *Diorama von Neandertalern von E. Daynès. Krapina-Höhle, Gespanschaft Krapina-Zagorje (Kroatien), 2010.*

perhaps, our Neanderthals ended up with rather minimalist clothing‹ (Tattersall 1992, 85).

In terms of whole-body representation, from the late 1990s onwards E. Daynès quickly made a name for herself with her hyperrealistic mannequins (Daynès 2011). Her greatest diorama work is undoubtedly that of the Krapina Museum, Krapina-Zagorje County, in Croatia, made around 2008, featuring a dozen individuals – men, women and children (Fig. 16). Although they are supposed to represent the inhabitants of the Krapina Cave, which has yielded numerous Neanderthal individuals, they are inspired by many different, well-preserved skulls and skeletons from other sites, sometimes representing ›different versions‹ of the same individual (2x La Chapelle-aux-Saints; 3x Devil's Tower; 1x Shanidar 1, Erbil Governorate, Iraq; 1x Saccopastore, Rome, Italy; 1x Roc de Marsal, Dép. Dordogne [France], etc.). In the scene, the men return from hunting while the women sit around the hearth in the cave with their children. All are dressed in loincloths or skimpy tunics, or else they are naked, maybe again the same old ›clichés‹ inherited from the 19th century.

Since the 2010s, the Dutch Kennis brothers have also provided full-body reconstructions to museums in the UK, Germany and Denmark and for a book by A. Roberts et al. (2012). Provocative and smiling, the figures are very often nude or wearing skimpy clothing (capes, leggings, loincloths). Their most famous work is undoubtedly ›Mister N‹ in the Neanderthal Museum in Mettmann, Germany, with whom visitors like to photograph themselves, maybe because of his smiling and sympathic face (Fig. 17; Anderson 2011).

It is important to remember that, according to archaeological data, Neanderthals lived through several ice ages and interglacial periods in Europe, and they clearly had tools that indicate hide working (Claud et al. 2019). The study of their teeth also supplies evidence of hide working (Krueger et al. 2017), as do faunal cut marks (Russo et al. 2023). While their work with skins is well known, in fact often represented in reconstructions as an action or gesture, particularly by women shown processing skins in dioramas from various eras, there does not seem to be any link to showing Neanderthals in appropriate clothing.

We can therefore imagine three scenarios: first, that the palaeo-artists – imbued with over 150 years of images of reconstructions of prehistoric people – couldn't imagine Neanderthals as anything other than nude or in loincloths;

second, they saw them as less gifted at sewing – not yet having the needle – and so chose to depict a simpler garment; or finally, they pictured them during milder interglacial phases and therefore less warmly dressed.

What has changed a bit since the 2010s, however, is the knowledge that Neanderthals used pigments (red and black), large feathers, and adornments such as raptor talons and shells (Fig. 18; Frayer 2019). Some reconstructions, therefore, have added these elements. The representations have also become more humanised since learning from aDNA analyses in 2010 that Neanderthals and modern humans interbred (Green 2010). Even though these reconstructions do not appear warmly dressed, they seem much more friendly than in earlier versions.

### *Homo sapiens* (300–10 kya ago) in present-day reconstructions

While Neanderthals tend to be depicted ›undressed‹ over the course of the 20th century – the reconstructions in which they are warmly clothed being the earliest – the opposite has happened with *Homo sapiens.* Recent representations of *Homo sapiens* in museums tend to show them warmly clothed for the most part (81 %). Taking into account the cold climate, access to sewing needles and the desire (again and again) to emphasise our modern human superiority, individuals have tended to be better covered. Reconstructions are still inspired by ethnographic analogies but have shifted to individuals living under similar climatic and ecological

**Fig. 17** Mister N. Neanderthal by A. Kennis and A. Kennis. Neanderthal Museum in Mettmann (Germany).

***Abb. 17*** *Mister N. Neandertaler von A. Kennis und A. Kennis. Neanderthal Museum in Mettmann (Deutschland).*

**Fig. 18** Neanderthal bust by F. Fogliazza, Museo de la Evolución Humana, Burgos (Spain).

***Abb. 18*** *Neanderthalerbüste von F. Fogliazza, Museo de la Evolución Humana, Burgos (Spanien).*

conditions, usually involving reindeer, such as Inuits or Chuckchi (Beyries 2002). These ethnographic comparisons are no longer associated with the idea of savagery, as most recent museums, such as the *Musée de l'Homme* in Paris, or the *Musée des Confluences* in Lyon (France) address ethnographic questions with much greater respect and sensibility.

Archaeological evidence for hide working and sewing is better known for *Homo sapiens* than for Neanderthals – even for the Aurignacian and Gravettian periods before eyed needles – with numerous finds of scrapers (Aleo et al. 2021), punches, and more recently, evidence for shoes from the Cussac Cave (Ledoux et al. 2021).

Even so, arms, legs and feet are often shown bare, even for reconstructions of individuals who lived during the last glacial maximum. Dark skin colour for *Homo sapiens*, known from aDNA (Jablonski 2021; Ju/Mathieson 2021), has been gaining ground in new productions by paleo-artists since about 2014, albeit with considerable inertia, since the first mention by S. Beleza et al. (2013) of a lightening of skin colour pigmentation for europeans and asiatic people between -19 kya to -11 kya (Beleza et al. 2013, 24) or much later after 6 kya (Jablonski 2021, 720). For example, the

**Fig. 19** Lady of Cavillon, by E. Daynès 2022. Cosquer Mediterrannée, Marseille (France).

***Abb. 19*** *Die Lady von Cavillon von E. Daynès. Cosquer Mediterrannée, Marseille (Frankreich).*

famous french sculptor E. Daynès – who had worked closely with scientists – did a reconstruction of the Pataud woman (Pataud 1, Dép. Dordogne) for the Musée des Confluences, Lyon (France), in 2014 with – for the first time – a more darker skin than she used to do for her previous Palaeolithic reconstruction. She did the same, more recently for her »Lady of Cavillon« of Cosquer Méditerranée Museum, Marseille (France), in 2022 (Fig. 19)[12]. In 2018 or 2019, P. Froesch, on the indications of the anthropologist A. Balzeau, changed the 3D reconstruction of Cro-Magnon 1 he did, and add a darker skin pigmentation shortly after first public press publications (A. Balzeau 2023, pers. comm.).

In the United Kindom, the swedish sculptor O. Nilsson did a reconstruction of a bust of Cro-Magnon 1 with a dark skin, around 2019, facing a white skinned and red haired Neanderthal woman for the Brighton Museum.

For two illustrators used to work with museum as painters, A. Roudier and G. Tosello, the change in skin colour for *Homo sapiens* happened for the first one in 2016 (Balzeau/Roudier 2016, 22, 65) and for the second only in 2024 for the ›La vie au grand air‹, a special exhibtion of the Musée National de Préhistoire, Les Eyzies, Dordogne (France; La vie au grand air 2024, 149, 153) about open air settelments of the Solutrean culture, on the indications of the scientific comitee (C. Cretin, pers. comm.).

It is also to notice that dark skin colour for *Homo sapiens*, started to be more often reconstructed mainly since 2021 for TV documentaries (*First peoples*, 2015; *Ladies and Princes of Prehistory*, 2021; *Lady Sapiens*, 2021).

## Conclusion

In the various examples cited here, one can see that palaeoartists often sought to keep abreast of the archaeological knowledge of their time, even in the early 19th century, and that they often drew inspiration from ethnography (for good or bad). This seems only natural for such a thorny

12 2014 is also the beginning of much more prehistoric women *(Homo sapiens)* being reconstructed. In June 2025, for the Lascaux 3 travelling exhibition in Bordeaux she modified the colour skin for her four *Homo Sapiens* individuals by darkening their skin (Chancelade man, Lady of St Germain la Rivière, Cap Blanc Magdalenian woman and a non identified child).

issue as clothing, which was rarely preserved; nevertheless, the sources of comparison were not always taken from similar climatic and ecological conditions.

We might wonder whether old clichés engendered always the same images, creating what W. Stoczokwki, inspired by R. Barthes, called a ›misleading reality effect‹ (Stoczokwki 2010, 65): the more an image is repeated, the truer it seems to us. This is even more the case the more often an image is reproduced, to the point of forgetting that we don't know much about the body hair of Palaeolithic people or what they actually wore.

It is amusing to see images become credible again today after having previously been dismissed by scientists. For example, *Homo sapiens* are now shown well and warmly covered, as were the mannequins in the *Musée de l'Artillerie* since 1876 and the second edition of L. Figuier's *L'homme primitif* in 1870, or are now reconstructed with dark skin, as were some L. Mascré's and A. Rutot's busts c. 1909–1914.

When it comes to the clothing of Neanderthals, the question continues to divide prehistorians. For example, Gilligan (2018) and Collard et al. (2016) say that Neanderthal clothing must have been simple since they did not yet have eyed needles. But is this so obvious? Is it really evidence? As mentioned above, an article of É. Claud et al. (2019) put formal traceology of Neanderthal's tools showing evidence of use-wear associated with cutting, scraping and hide piercing.

So, do we clothe prehistoric mannequins in museums for reasons of archaeological knowledge or for the modesty of the audience? Do we leave them naked to display their anatomy or because we think they lived naked? Or is it because of the ›impression of reality‹, the heritage of ancient images and, therefore, the repetition of errors or approximations from the past, that we prefer recreating them in nakedness or loincloths instead of clad in warm clothes? Do we want – consciously or not – to give the impression that *Homo sapiens* is superior to other species? It is high time we asked ourselves these questions.

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# Stone Age clothes in popular media – a balance between producers, audiences, and sciences

Kayleigh Saunderson, Lukas Dobler, and Karina Grömer

**Zusammenfassung**

Steinzeitkleidung in populären Medien – ein Gleichgewicht zwischen Produzenten, Publikum und Wissenschaft

*In der Öffentlichkeit gibt es klare Vorstellungen vom Aussehen eines steinzeitlichen (meist paläo- oder mesolithischen) Menschen, welche jedoch laufend variieren, und diese Ideen sind in populären Medien wie Comics, Fernsehserien, Videospielen und Filmen zu sehen. Viele dieser Bilder stammen aus der wissenschaftlichen Forschung oder sind zumindest von ihr beeinflusst sowie in einigen Fällen eindeutig von rekonstruierten Bildern in Museen inspiriert. In anderen Fällen weichen die Darstellungen in den populären Medien stark von den wissenschaftlichen Erkenntnissen ab. Dies geschieht nicht ohne Grund, denn wissenschaftliche Genauigkeit oder Authentizität ist nicht das einzige Ziel der Produzenten und nicht das einzige Interesse der Konsumenten. Es wird ein Gleichgewicht angestrebt zwischen historischer Genauigkeit, dem, was die Produzenten zeigen wollen, und dem, was das Publikum erwartet bzw. sehen möchte. Diese Erwartungshaltungen ändern sich auch im Laufe der Jahrzehnte.*

*Allerdings beeinflussen diese Darstellungen von Kleidung und Aussehen in der Steinzeit in den populären Medien wiederum die Vorstellung des Publikums von den tatsächlichen Steinzeitmenschen. Das wirft die Frage auf, welche Ausgewogenheit im Hinblick auf die Einbeziehung der wissenschaftlichen Forschung erforderlich ist und welche Verantwortung die Archäologen mit ihrer Forschung und im Rahmen der Wissenschaftskommunikation haben. Im vorliegenden Beitrag werden diese Aspekte anhand mehrerer Fallstudien untersucht.*

**Schlagwörter** Visuelle Identitäten, Videospiele, prähistorische Kleidung, Rekonstruktionen, visuelle Medien

**Summary**

*Among the general public, there are clear but everchanging ideas of a Stone Age (usually Palaeolithic or Mesolithic) person's appearance, and these images can be observed in popular media, such as comics, TV series, video games, and movies. Many of these images derive from or are at least influenced by scientific research, in some cases clearly inspired by recreated images in museums. In other cases, appearances in popular media strongly deviate from scientific evidence. This is not without cause, since scientific accuracy or authenticity is not the sole goal of producers and not the only interest of audiences. One can observe a balance between historical accuracy, what producers aim to show, and what an audience expects and enjoys, which is also subject to change across the decades of production.*

*However, these presentations of clothing and appearance in the Stone Age in popular media again influence the public's idea of actual Stone Age people, which begs the question of what balance is needed regarding the incorporation of scientific research and also what the responsibility of archaeologists is with their research and public science communication. In this contribution, these aspects are explored through multiple case studies.*

**Keywords** Visual identities, video games, prehistoric clothing, reconstructions, visual media

## Introduction

Visual identities have previously been discussed for prehistoric societies based on archaeological evidence[1]. Many images and ideas about specific time periods, cultures, and societies have evolved – and also changed over time – in the public mind, not necessarily reflecting the historical realities. These images are manifested in popular media, such as movies, cartoons, TV series, and video games. They are influenced by multiple factors, such as current fashion, politics, ideals, education; research conducted and shared by archaeologists also has a significant impact. This begs the question of what archaeologists' responsibilities are to the public and thus to popular media, which in most cases may shape people's ideas of the clothing and appearance of past societies much more than museum exhibitions and scientific literature. In movies and TV series, clothing plays a vital role in storytelling (e.g. Aldrete/Sumner

1 E.g. Eicher-Evenson 2015; Grömer et al. 2024; Huijsman et al. 2024; Martin/Weetch 2017; Roach-Higgins et al. 1995; Sørensen 1997.

**Fig. 1** Idealised image of Palaeolithic people, living in caves. »*Idealbild aus der Steinzeit. Höhlenbewohner*«, by Hugo Darnaut, 19th century.

***Abb. 1*** *Idealisiertes Bild paläolithischer Menschen, die in Höhlen leben.* »Idealbild aus der Steinzeit. Höhlenbewohner«*, von Hugo Darnaut, 19. Jh.*

2023; Llewellyn-Jones 2018; Powell 2023). The costumes, in many cases, are not representative of historical or archaeological research, which is also not the aim of their design. Instead, they often reflect the expectations of the audiences – »creating the illusion« – as expressed in the title of a book on Hollywood costume design by J. Jorgensen and D. L. Scoggins (2015). Video games are one form of popular media where immersion and character design play important roles, and thus also the clothing. The costumes bring a further dimension to the playable character(s), making some aspects of visual identities resemble real life. In some games, the playable character can be seen as somewhat of an avatar, where its appearance can be changed by the player.

## Bridging the gap between archaeology and the public

As archaeologists, our research perspective usually starts with the material culture – the finds – from which aspects of the lives and behaviours of past societies can be identified to a certain extent. Communicating these research results to the public without elucidating each step of the methodology can sometimes be challenging, especially when only minute traces survive. The Palaeolithic and Mesolithic periods usually leave only small finds, which do not produce a clear image of Stone Age life when shown in museums. At this point, visual reconstructions are vital tools for showing imagined scenes from daily life when based as closely as possible on the available evidence. For the Palaeo- and Mesolithic periods, such reconstructions are usually paintings or digital artistry, but dioramas and life-sized recreations of clothing are also options. However, they are always witnesses of a specific period (when they were made) and a specific *Zeitgeist*. This is clearly demonstrated by the painting of »Idealised Palaeolithic Cavemen« found in Hall 11 at the Natural History Museum Vienna (Fig. 1).

## Clothing to create or fit a narrative

However, these images are not restricted to museums or other scientific contexts. Many examples of popular media are set in (pre-)historical eras or inspired by them, e.g. in the fantasy genre (usually the Middle Ages and Renaissance) but sometimes in the science fiction genre, as well (Jensson 1987). Here, the costumes are a crucial narrative element, describing the character non-verbally and immediately. Features such as functionality are sometimes completely left aside – for example a female warrior's armour that more or less consists of items resembling a bikini; here, the image seems more important than the actual protection.

An example is the widely known *Asterix and Obelix* series (comic books by R. Goscinny and A. Uderzo, 1959 to present), set in Gaul in the year 50 BC. Here, the differences between the Gauls and Romans are very clearly communicated through the characters' appearance and clothing: The Gauls are often displayed with a moustache, trousers (often overexaggerated, e.g. as worn by Obelix), and striped or chequered garments. Also, the iconic helmet worn by Asterix has wings, resembling Late Bronze Age helmets, such as from Pass Lueg in Austria. Typical Celtic helmets are different (Fig. 2). Though there are known finds of Attic

**Fig. 2** Comparison between Celtic helmets at the Natural History Museum Vienna and the visual design of the comic series *Asterix*.

***Abb. 2*** *Vergleich zwischen keltischen Helmen im Naturhistorischen Museum Wien und der visuellen Gestaltung der Comicserie* Asterix.

winged helmets and also a La Tène helmet with a bird with massive wings from Ciumești, Romania (Rusu 1969), it probably did not serve as inspiration directly for the design of Asterix' helmet. Most likely the inspiration derives from the fantastical 19th century depictions of Vercingetorix. Though the display is far from historically accurate, the inspiration from archaeological and historical research is clear[2]. On the other hand, the Romans are clean-shaven, wear Roman-inspired armour (sometimes togas), and do not wear trousers. The reference to trousers is especially interesting, as there is a literary evidence fitting the narrative of *Asterix and Obelix*. In the 1st century BC, Diodorus describes the Gauls as wearing colourful clothing, featuring stripes and cheqs, as well as trousers (Diodorus Siculus, Bibliotheca historica V, 30). This was a striking difference for the Romans at the time, who did not wear trousers.

Differences in narratives told through clothing can contrast sharply when similar stories produced at different times are compared. For example, the legend of Arthur, perhaps dating to the 5th or 6th century, has been presented many times in popular media, with Queen Guinevere portrayed in varied ways. To mention just one comparison, in the movie *Knights of the Round Table* (1953), she is a delicate damsel, sometimes dressed in white to symbolise her innocence. In *King Arthur* (2004), however, Guinevere's image is quite the opposite: here, she is a warrior, seemingly inspired by a Celtic warrior cliché, wearing barely any clothing, leather, and blue paint. Neither of these portrayals displays Late Antique or Early Medieval clothing based on known sources.

## Authentic versus inauthentic – is it that simple?

As archaeologists or history buffs, it might seem tempting to point out each historical inaccuracy in movies, video games, and other media, and ›authenticity‹ in popular media is difficult to define (Houghton 2022, 1–3). However, media producers often have many other things in mind besides historical accuracy and have other goals than archaeologists who create reconstructions. The visual codes shown through clothing in media always reflect the time of production (e.g. Aldrete/Sumner 2023; Jorgensen/Scoggins 2015) as opposed to the visual codes of history (see Grömer in this volume), which, themselves, are challenging to identify. Thus, the main characters in movies or drama series with prehistoric, antique, or historical content usually represent a ›historic spirit‹ composed of garment designs, hairstyles and jewellery that are combined to create a ›period look‹ but reflect the *Zeitgeist* of the era the movie was made to attract the contemporary audience. Connecting current visual codes with impressions of ancient times helps the consumers to dive into these past worlds and relate to the characters.

## The scruffy caveman – myth versus research

For movies, comics or even video games that deal with periods far back in time, it is usually the Palaeolithic and Mesolithic eras that are shown in media rather than the Neolithic, in which the sedentary lifestyle might seem similar to that of modern western people. The image people usually have in mind is that of a hunter-gatherer with unkempt hair, dwelling in a cave and wearing furs. Here, old stereotypes are shown, as perpetuated by images from the 19th century (Fig. 1). There are many ways in which the Stone Age has been displayed in popular media. Compared to the Medieval period, often depicted as the literal ›Dark Ages‹ (von Taeuffenbach 2023, 22), lacking colour and with a dark filter added, the Stone Age is usually shown in brighter hues, emphasising the colours of nature and thus bygone times. Various Stone Age periods are rarely differentiated but seen

2 E.g. Iron Age textile patterns: see Grömer 2023, Fig. 99; Iron Age garments: see Schlabow 1976.

**Fig. 3a–b** Reconstruction of a Palaeolithic upper garment as presented at the Natural History Museum Vienna (a), based on finds of ivory beads from Grub Kranawetberg, Lower Austria (b), c. 30 000 years old.

***Abb. 3a–b*** *Rekonstruktion eines paläolithischen Obergewandes, wie es im Naturhistorischen Museum Wien präsentiert wird (a), basierend auf Funden von Elfenbeinperlen von Grub Kranawetberg, Niederösterreich (b), ca. 30 000 Jahre alt.*

as one distant time in prehistory – sometimes even including dinosaurs or other anachronistic fauna.

## Sources of Palaeolithic and Mesolithic clothing and reconstructions

Clothing in the form of preserved garment remains can only be proven from the Neolithic period onwards. From this time in prehistory, a wide variety of sources, including almost complete garments, textile fragments found in settlement and burial contexts, finds of costume components and jewellery, as well as pictorial and written evidence, provide a more detailed picture of our ancestors' clothing (Grömer 2023, 335–470). For the Palaeolithic and Mesolithic periods, many of these sources do not exist or are still unknown. As a result, there is no direct evidence for clothing from these earlier periods. It is only possible

to infer clothing from indirect evidence (Gilligan 2010, 32; Merthen 2015, 10–27), such as pieces of jewellery sewn onto clothing or evidence for sewing needles. Most spectacular are the Palaeolithic burials from Sungir in Russia (Bader/Lavrushin 1998), where individuals have been found who apparently had rows of thousands of ivory beads been sewn onto their garments – their placement clearly suggesting tunics and leg covers. Jewellery from the hunter-gatherer period, including ivory beads or perforated shells, can also be found in Palaeolithic settlements in Europe (Fig. 3), e.g. the Gravettian site of Grub-Kranawetberg in Austria (Antl 2018).

The Australian archaeologist Ian Gilligan has introduced a concept that classifies Pleistocene clothing into two categories: simple and complex. Simple clothing is single-layered and not tailored to the body, while complex clothing has two or more layers and is tailored to the body. Complex clothing also protects against natural phenomena such as rain or wind. Another distinction between simple and complex clothing is the manufacturing technique, which will be illustrated using the example of animal skins. Simple clothing only requires scraping tools to process the skin. If the pelts were small, piercing tools, such as bone awls, may also have been necessary to join the skins together. On the other hand, complex clothing requires special tools for scraping, cutting and piercing (Gilligan 2010, 24–26).

Gilligan identifies the presence of specific stone tools and technologies as potential indirect evidence for Pleistocene clothing. Other indirect evidence includes the exploitation of animals and plants (Gilligan 2010, 32). Additional insights can be drawn from known climate and weather conditions, as well as the thermal requirements of Palaeolithic and Mesolithic environments (Gilligan 2010, 17–18).

## The Stone Age in popular media

A well-known example is the animated sitcom *The Flintstones* (by W. Hanna and J. Barbera, first aired in 1960). It is obviously not trying to depict the Stone Age realistically but rather humorously, combining elements of the Stone Age with the 1960s and including dinosaurs. Regarding clothing, the character Fred Flintstone wears fur clothing, but also a necktie; the hairstyles are typical of the 1960s, but Pebbles Flintstone adds a bone to her hair.

The racing video game *Cro-Mag Rally* (developer: Pangea Software, published by Aspyr 1998) has some similarities in the design of the characters' clothing, likely inspired by *The Flintstones*. While the playable characters fit the cave dweller cliché, wearing fur clothing and tooth jewellery, the vehicles and settings are humorous twists on various (pre-) historical eras.

A more realistic approach can be seen in the survival and city-building video game *Dawn of Man* (developer and publisher: Madruga Works, 2019). In this game, the player can start in the Palaeolithic period, organising the life of hunter-gatherers and advancing to the Mesolithic, Neolithic, Chalcolithic, Bronze Age, and Iron Age by learning new technologies. With each period, the clothing also changes and is quite accurately based on archaeological research.

Some depictions of the Stone Age can be problematic for multiple reasons, such as the movie *10,000 BC* (producer: R. Emmerich, 2008). While we do see some inspiration from Mesolithic archaeology, such as the Shaman from Bad Dürrenberg in Saxony-Anhalt (Germany) (Meller/Michel 2022; Orschiedt et al. 2023), we also see finely woven, blue-dyed garments, at least 8000 years too early. This costume aimed to match clichés of clothing in a warm climate and to let the main character stand out, while designed with a modern look.

An interesting example of the Stone Age inspiring science fiction media is the video game *Horizon: Zero Dawn* (developer: Guerilla Games, publisher: Sony Interactive Entertainment, 2017), which is set in post-apocalyptic North America in the 31st century. It features tribal societies of hunter-gatherers and shamans, whose identities are clearly communicated through the characters' clothing, especially members of the »Nora tribe« – obviously inspired by Stone Age archaeology – whose wardrobe consists of skins and furs. However, the game and its costumes show an admixture of science fiction, i.e. necklaces made from robotic parts.

## Case study: Far Cry Primal

The following analysis focuses on the video game *Far Cry Primal*. Developed and released in 2016 by the French video game company Ubisoft, *Far Cry Primal* is a single-player, first-person shooter game set in Central Europe around 10 000 BC during the Mesolithic period. As an open-world game, it allows players to explore and navigate the game world freely. The storyline follows Takkar, an unarmed hunter who must return to his tribe. Players are tasked with crafting weapons and clothing from gathered materials, as well as sourcing food through hunting and foraging.

How were the game's setting, characters, and other elements created? In an interview (Te 2016), game developer K. Shortt explained that once the decision was made to set the game in 10 000 BC, the team began with thorough research. They consulted anthropologists and linguists to ensure a degree of authenticity while maintaining creative freedom. Shortt emphasised that, while the roles, such as shamans, warriors, and hunters, had to make sense for the hunter-gatherer period, the team also aimed to make these characters unique, eccentric, and entertaining (Te 2016).

Additional insights from Ubisoft's website reveal that the production team maintained constant contact with experts to create an authentic setting (Ubisoft 2016). However, they also identified areas where historical evidence was sparse, allowing for creative interpretation. According to Ubisoft, the scarcity of evidence from this period, primarily limited to stone and bone artefacts, gave the team greater freedom to develop imaginative elements while still grounding the game in historical plausibility (Te 2016).

In summary, while efforts were made to create a realistic setting and foundation for the characters and their clothing, the game's development also allowed significant creative freedom: the language spoken by the characters was invented, and some animals featured in the story did not exist around 10 000 BC. For instance, the genus *Megacerops* is depicted in the game, although humans could not have

**Fig. 4** Reconstruction of the Shaman of Bad Dürrenberg, Saalekreis District (Saxony-Anhalt). Painting by Karol Schauer, Salzburg.

***Abb. 4*** *Rekonstruktion der Schamanin von Bad Dürrenberg, Saalekreis (Sachsen-Anhalt). Gemälde von Karol Schauer, Salzburg.*

encountered it. Nevertheless, the representation of characters and their clothing seems to draw inspiration from archaeological sources.

The portrayal of clothing involves a blend of imagination and archaeological evidence. Players can craft their own garments in the game by hunting specific animals, skinning them, and using plants as binding materials. Additionally, many characters are depicted wearing necklaces or bracelets made of bones or shells – a type of jewellery known from many Palaeolithic and Mesolithic sites.

## The Shaman of Bad Dürrenberg – a major source of inspiration

This burial of the Shaman of Bad Dürrenberg was discovered in 1934 and is located in the German state of Saxony-Anhalt (Meller/Michel 2022; Orschiedt et al. 2023). The grave contained a woman and a child accompanied by rich grave goods. These included over 140 artefacts made from animal bones, turtle shells, 120 fragments of freshwater mussels and much more. Exceptional finds included, for example, a crane bone that served as a container for over 30 microliths, many pendants made from the front teeth of bison, deer and roe deer and one antler of a roebuck, which served as a headgear (Orschiedt et al. 2023, 126). Many of the bones show signs of artificial processing. Due to these circumstances and the woman's bodily anomalies (Orschiedt et al. 2023, 127–128), this grave is interpreted as a shaman's grave. The Shaman of Bad Dürrenberg (Fig. 4) may have served as a model for the character of the shaman in the game *Far Cry Primal* (Fig. 5; Te 2016). Tensay, the shaman from *Far Cry Primal*, is depicted wearing antlers on his head and adorned with various types of jewellery, including teeth, animal bones, and numerous shells.

The shaman »Old Mother« from the film *10,000 BC* (2008) and the shaman from the movie *Alpha* (2018), also resemble the Bad Dürrenberg Shaman, particularly in their use of jewellery made from animal bones and teeth. Even stronger parallels can be observed in the character of the shaman from the TV series *Barbarians* (2020), who closely resembles the reconstruction of the Shaman of Bad Dürrenberg, despite the fact that the series is set much later, during the Roman occupation of Germania Magna in 9 AD.

**Fig. 5** The shaman from the video game *Far Cry Primal.*

***Abb. 5*** *Der Schamane aus dem Videospiel* Far Cry Primal.

## Conclusion

The inspirations taken from research in popular media are very diverse, appearing in contexts ranging from humour to science fiction and more realistic depictions. Public ideas of Stone Age clothing are then reinforced by these depictions. This results in people being more strongly influenced by images in popular media than by museums, documentaries, or other scientific sources, and therefore believing fantastical appearances to be historical fact. However, both media producers and researchers bear some degree of responsibility – or at least have the power – to improve the public's understanding of prehistory. A powerful example of the impact of a recreated image is the Shaman of Bad Dürrenberg, which has been adapted for video games, TV series, and films.

Thus, we propose more such high-quality reconstructions or recreations be made and presented to the public in museums and popular science publications. Although it can be challenging to recreate the visual appearance of prehistoric people, attempts based on the evidence we have are already valuable, and uncertainties can even be shown with different variations. We also suggest increasing the communication between researchers and those producing historically-themed popular media, thus better reflecting scientific research and also taking into consideration the perspectives of both sides when discussing the »balance« necessary between producers, scientists, and the audience.

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## Source of figures

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# SEKTION II: GRÜNDE, WARUM SICH MENSCHEN KLEIDEN

# SECTION II: REASONS WHY HUMANS DRESS

Eine Schneiderpuppe (Foto: JSB Co. auf Unsplash).

*A tailor's dummy (Photo: JSB Co. on Unsplash).*

# The transition to clothing as dress

Ian Gilligan

**Zusammenfassung**

Der Übergang der Bekleidung als Körperschmuck

*Es gibt Belege aus verschiedenen Fachrichtungen, dass Kleidung bei einem biologisch nackten Primaten, der im Pleistozän massiven Schwankungen der Umgebungstemperaturen ausgesetzt war, als Schutz vor Kälte entstand. Das pragmatische Motiv für die Einführung von Kleidung wirft jedoch die Frage auf, wann und warum Menschen begannen, Kleidung als eine Form des Körperschmucks einzusetzen. Tatsächlich war die Verwendung von Kleidung als persönliche und soziale Zurschaustellung oder als Aufmachung in vielen Teilen der Welt während der gesamten historischen Ära der Hauptgrund für das Tragen von Kleidung. Thermische Aspekte sind oft von untergeordneter Bedeutung, wenn nicht sogar völlig irrelevant. Jüngste archäologische Entdeckungen und theoretische Neuformulierungen werfen ein Licht auf diesen entscheidenden Prozess, bei dem Kleidung von einer thermischen zu einer sozialen Notwendigkeit wurde. Man kann zwischen einfacher und komplexer Kleidung unterscheiden, wobei letztere enganliegende Kleidungsstücke umfasst, die den Körper vollständiger bedecken und die Verwendung von Kleidung als eine Art von Aufmachung oder »Tracht« fördern. Dekorative Artefakte wie durchbohrte Muscheln und Perlen wurden während des letzten Eiszeitzyklus in kühleren Teilen Afrikas immer häufiger, was mit der Entwicklung komplexer Kleidung in kälteren Klimaphasen zusammenfiel. Die russische Fundstätte Sungir bestätigt das Vorhandensein komplexer, reich verzierter Kleidung vor 34 000 Jahren. Zu dieser Zeit war die menschliche Körperoberfläche stärker bedeckt und für die Übermittlung sozialer Inhalte weniger geeignet, was eine funktionale Verschiebung der Kleidung begünstigte, die in der Folge zu einem globalen Phänomen wurde.*

**Schagwörter** Kleidung, Schmuck, Mode, Paläolithikum, Pleistozän

**Summary**

*Evidence from a range of disciplines indicates that clothing originated as protection from cold for a biologically naked primate exposed to massive fluctuations in environmental temperatures during the Pleistocene epoch. However, a pragmatic motive for adopting clothes raises the question of when and why humans began to deploy clothing as a form of body adornment. Indeed, the use of clothing as personal and social display, or dress, has been the main reason for wearing clothes in many parts of the world throughout the historical era. Thermal issues are often of secondary import, if not entirely irrelevant. Recent archaeological discoveries and theoretical reformulations are shedding light on this pivotal process whereby clothes transitioned from a thermal to a social necessity. A distinction can be made between simple and complex clothing, with the latter comprising fitted garments that provide more complete body cover, promoting the use of clothing as dress. Decorative artefacts such as pierced shells and beads became increasingly common during the last glacial cycle in cooler parts of Africa, coinciding with the development of complex clothing during colder climate phases. The Russian site of Sungir confirms the presence of complex, highly decorated clothing 34 000 years ago. By that time, the human body surface was more fully covered and rendered less accessible for social purposes, favouring a functional shift in clothing which has subsequently become a global phenomenon.*

**Keywords** Clothing, adornment, fashion, palaeolithic, pleistocene

## Introduction

Clothing is now the dominant form of human body adornment, the most visible means of altering our naked appearance for social and psychological purposes. As natural as this situation may seem for those people habituated to wearing clothes – and for those residing in social environments where the wearing of clothes is sanctioned – anthropological evidence shows that the use of clothing as body adornment is not intrinsic to being human. On the contrary, ethnographic data demonstrate that many hunter-gatherer societies functioned without clothes, weather permitting, and people dressed themselves adequately – often quite elaborately – with alternative decorative techniques, such as body

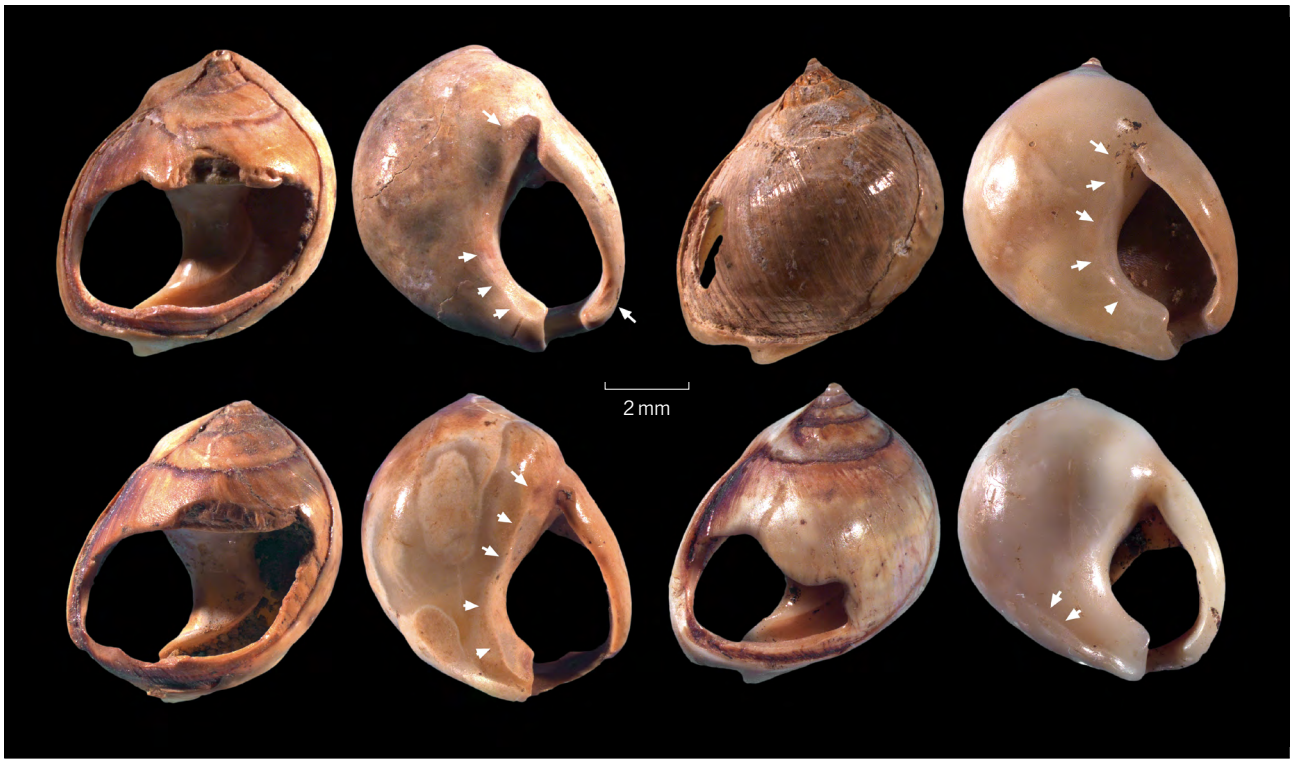



**Fig. 1** Shell beads from Blombos Cave's Still Bay layers, Western Cape Province (South Africa), dated to c. 73 000–70 000 years ago. Arrows indicate use wear facets.

***Abb. 1*** *Muschelperlen aus den Still-Bay-Schichten der Blombos-Höhle, Provinz Westkap (Südafrika), datiert auf ca. 73 000–70 000 Jahre vor heute. Die Pfeile heben Abnutzungsfacetten hervor.*

painting, scarification, and tattooing. Likewise, while direct archaeological evidence for Palaeolithic clothing is essentially non-existent, indirect evidence indicates that clothing is a relatively recent innovation in hominin prehistory.

## Clothing origins

The Pleistocene epoch presented serious thermal challenges as hominins migrated into middle latitudes. In particular, a substantial reduction in body hair cover – likely established prior to the Pleistocene (Rogers et al. 2004; Reed et al. 2007) – placed a premium on developing technologies that could provide adequate portable insulation from cold temperatures and wind chill. Control of fire offered only limited warmth in the open, and shelters (caves, rock shelters, and artificial shelters) could offer no protection outdoors. Environmental and physiological contingencies constitute the prehistorical context for the invention and elaboration of clothing. As clothing became more sophisticated and its use more regular – notably among mid-latitude *Homo sapiens* populations during the last glacial cycle from c. 120 000 years ago – a number of social and psychological repercussions of routinely covering the naked human body began to emerge (Gilligan 2016; Gilligan 2019). The main psychological consequence was physical modesty, a sense of shame about appearing naked. The main social consequence was the transfer of body decoration from the surface of the human skin onto the more visible surface of clothes, resulting in the use of clothing as dress (Gilligan et al. 2024). Together, these two consequences of clothing – modesty and dress – encouraged the continued use of clothing for non-thermal reasons in some regions of the world at the outset of the Holocene epoch.

## Simple and complex clothing

Simple forms of clothing comprise garments worn loosely on the body, such as capes, cloaks, and loincloths. Complex clothes are fitted, i.e. tailored to enclose the body quite closely, and often enclose the limbs, e.g. shirts with sleeves, and trousers. Complex clothing assemblages can also be multi-layered. The distinction between simple and complex clothing is important for a number of reasons which include the question of clothing origins, physiological aspects of clothing, archaeological evidence for Palaeolithic clothing (especially technological correlates), and repercussions of wearing clothes, notably the emergence of clothing as dress[1].

1 Gilligan 2010, 63–65; Gilligan 2019, 90–92; d'Errico 2024, 5–11; Gilligan et al. 2024, 3.

Simple clothing likely had many independent origins extending into the Middle Pleistocene, if not earlier. Simple clothes were adopted and discarded in response to environmental conditions, and these garments did not acquire any enduring psychological or social purposes. With regards to dress, simple clothes did not interfere with traditional methods of adorning the body, such as body painting, tattooing, and deliberate scarification.

## Complex clothing and body adornment

The advent of complex clothing was limited to the Late Pleistocene, judging from available evidence (Gilligan 2010, 43–53; Gilligan et al. 2024, 3–6). The archaeological evidence includes likely technological correlates of manufacturing complex clothes. Simple clothing generally requires little more than hide-scraper tools. Complex clothing requires hide-scrapers but also hide-cutting tools (e.g. lithic blades) and hide-piercing tools, e.g. bone awls and eyed needles. While eyed needles have traditionally been viewed as an archaeological signature for tailored garments, recent re-evaluations of the evidence suggest that eyed needles were not required to sew fitted garments – alternative technologies such as lithic borers and bone awls were adequate for the task (Calvo et al. 2019, 427; Doyon et al. 2023, 9–11). Rather, the invention of eyed needles may relate to a need for finer sewing connected with making very delicate garments (e.g. underwear) and/or the more elaborate adornment of garments (d'Errico et al. 2018, 72; d'Errico 2024, 8; Gilligan et al. 2024, 3).

In contrast to simple clothes, the more-or-less complete and regular body covering associated with complex clothing necessarily restricted access to the naked skin surface for purposes of adornment, promoting the acquisition of decorative functions for clothing. Furthermore, whereas a thermal protective function for clothing is contingent on local environmental conditions, the social purposes of body adornment are enduring and essentially independent of environmental conditions.

## Evidence for adornment

The archaeological record for clothing in the Pleistocene epoch relies entirely on indirect or proxy evidence and, undoubtedly, the vast majority of body adornment must remain invisible. Nonetheless, adornment is attested archaeologically by a couple of findings, namely, the presence of ochre, and pierced items that served as beads. Ochre and beads can adorn the naked body, and both can also be used to decorate garments. While neither ochre nor beads are specific to clothing, the situation with beads is nonetheless more revealing with respect to the decoration of clothes.

### Ochre

Archaeological evidence for the use of ochre by hominins provides a reasonable proxy for body adornment, and ochre is found at sites in Africa, South-west Asia, and Europe from c. 400 000 years ago (Dapschauskas et al. 2022; Rosso 2022; d'Errico 2024, 11–12). Red is the most popular colour, followed by yellow and black. Ochre becomes more commonplace during the last glacial cycle, beginning at Blombos Cave, Western Cape Province (South Africa), 100 000 years ago (Henshilwood et al. 2011) and Qafzeh Cave, Northern District (Israel), 92 000 years ago (Hovers et al. 2003). In Siberia, ochre use is documented c. 43 000 cal BP at Kara-Bom, Altai Republic (Russia; Shunkov et al. 2020, 59). In China, ochre is present c. 40 000 cal BP at Xiamabei, North China (Wang et al. 2022), and c. 35 000 cal BP at Zhoukoudian Upper Cave, Beijing (d'Errico et al. 2021). Use of ochre – and probably manganese, if not related to making fire (Heyes et al. 2016; d'Errico/Soressi 2018) – is documented among Neanderthals (Soressi/d'Errico 2007; Roebroeks et al. 2012), and ochre is almost ubiquitous in Upper Palaeolithic burials (Pettitt 2010). Ochre is present from 42 000 cal BP in South-east Asia (Langley/O'Connor 2019). In Australia, ochre is found at sites dating from when humans arrived on the continent c. 50 000 years ago, if not earlier (Clarkson et al. 2017, 308–309).

In addition to decorating the skin surface, ochre was applied to clothes. Ochre is not restricted to decorating the unclad body, and therefore its presence at archaeological sites does not preclude the use of clothing. Ochre was probably utilized in tanning animal hides (Meller 2003; Rifkin 2011), and ochre is frequently found on tools used to manufacture clothing, such as hide scrapers, and sometimes on ornaments that might have been attached to clothes (Julien et al. 2019).

### Beads

Pierced shells and drilled bone beads – and similar items like drilled pendants – offer unequivocal evidence for adornment. Early examples in northern Africa are dated to late in marine isotope stage (MIS) 6, c. 142 000 years ago, and in MIS 5[2]. In southern Africa, early examples occur from 90 000 years ago[3], and during MIS 4 (Fig. 1).

Subsequently, beads are documented in South-west Asia and in South-east Europe c. 43 000 cal BP (Kuhn et al. 2009). Beads are common in European assemblages from ca. 42 000 cal BP (Vanhaeren/d'Errico 2006; d'Errico/Vanhaeren 2015; Baker et al. 2024). Beads also appear with Neanderthals in Châtelperronian contexts (Zilhão 2007, 24–27). In South-east Asia, beads occur from c. 42 000 cal BP (Langley et al. 2016; Langley et al. 2023), and in Australia from at least 30 000 cal BP (Morse 1993).

With the exception of ochre – and even ochre is ambiguous – body adornment in general suffers from limited

2 Vanhaeren et al. 2006; Bouzouggar et al. 2007; d'Errico et al. 2009; Steele et al. 2019; Sehasseh et al. 2021.

3 Henshilwood et al. 2004; Vanhaeren et al. 2013; Vanhaeren et al. 2019; d'Errico et al. 2005; d'Errico et al. 2023; Miller/Wang 2022.

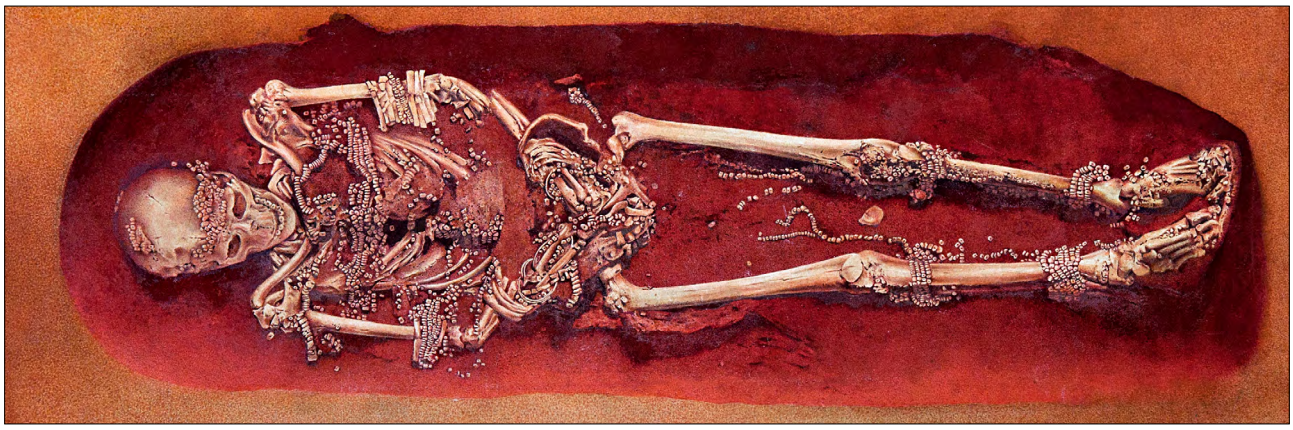


**Fig. 2** Burial of adult male (man Sungir 1) of the Sungir burial complex, Vladimir Oblast (Russia; lower tier), with the arrangement of mammoth tusk ivory beads indicating highly decorated fitted garments 34 000 cal BP.

***Abb. 2*** *Bestattung eines erwachsenen Mannes (Individuum Sungir 1) aus dem Sungir-Bestattungskomplex, Oblast Wladimir (Russland; untere Schicht), mit Elfenbeinperlen aus Mammutstoßzahn, die auf hochdekorierte, enganliegende Kleidung hinweisen, 34 000 Jahre cal BP.*

archaeological visibility. Beads are the best proxy but given the likely ubiquity of adornment among later – and perhaps earlier – hominins, the increased frequency of beads in the archaeological record of the last glacial cycle raises a question. Preservation and taphonomic issues may not suffice as explanations for the relatively recent increase in archaeological evidence for adornment. One possibility is that while adornment of the unclad body remains largely invisible, the adornment of clothing may be more visible, e.g. with shells and beads sewn onto garments. An increasing presence of beads during the last glacial cycle may therefore reflect the advent of complex clothing (Gilligan 2010, 53–56). In Australia, where only simple clothing was used (Gilligan 2007; Gilligan 2008), beads were less likely related to clothes but instead were deployed mainly in necklaces and similar decorative items (Wright et al. 2016; Balme/O'Connor 2019). In other regions though, use-wear evidence may be more suggestive of decorative artefacts being sewn onto garments. Use-wear findings consistent with attachment of beads to clothes are reported at Üçağızlı Cave, Hatay Province, in Turkey 41 000 cal BP (Stiner et al. 2013, 391), and at Shuidonggou 2 in north-eastern China c. 34 000 cal BP (Wei et al. 2016, 17). A pierced badger canine tooth at the Zhoukoudian Upper Cave also has use-wear consistent with attachment to clothes (d'Errico et al. 2021, 17–22). In northern Siberia, beads have been recovered in association with numerous bone awls and eyed needles at Yana RHS within the Arctic Circle, dated to 33 000 cal BP, with the beads probably sewn onto clothes[4]. The most compelling evidence for beads attached to complex clothing is found at the Russian site of Sungir, Vladimir Oblast, c. 34 000 cal BP[5].

## Sungir

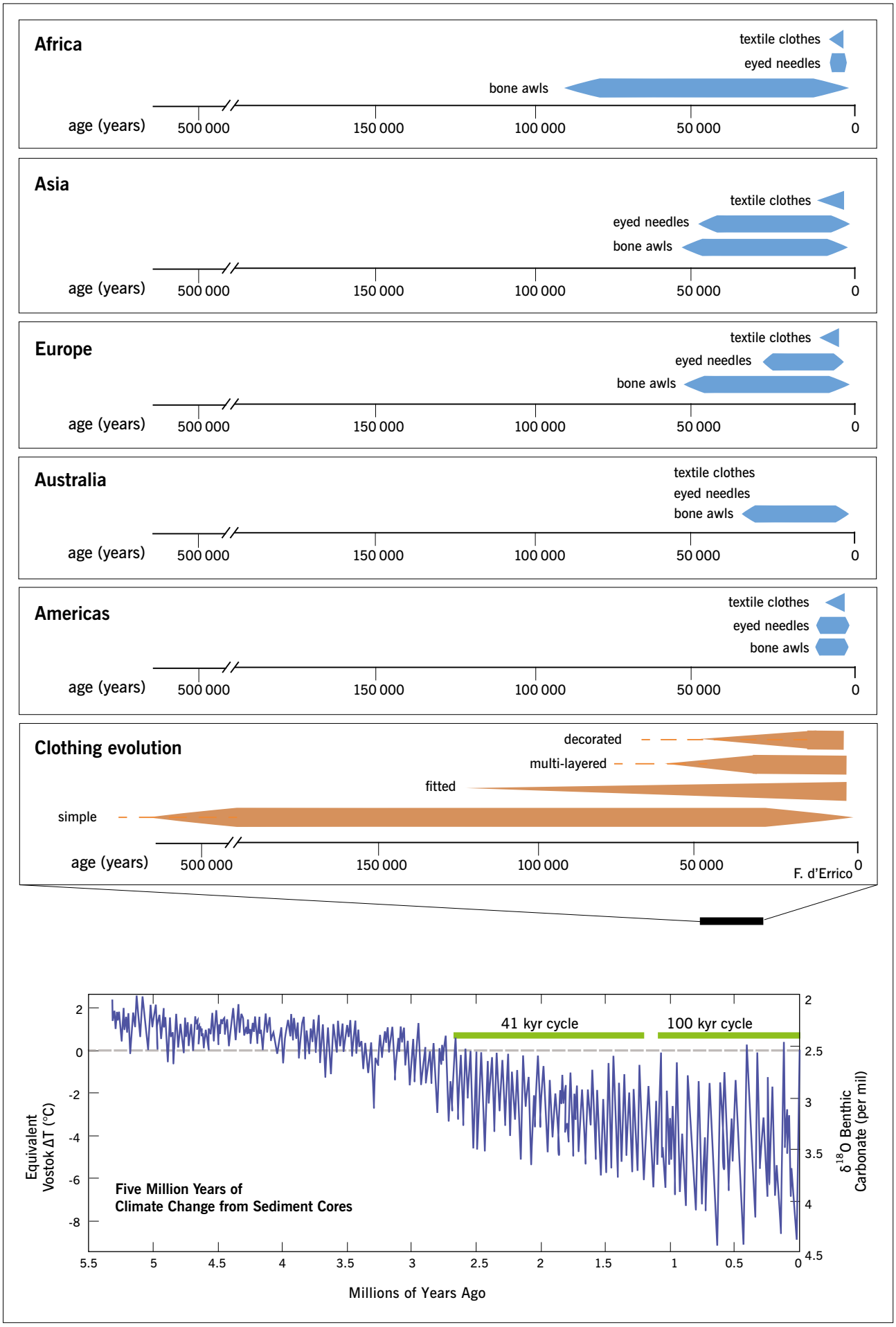
The arrangements of beads on human skeletons in graves at the Russian site of Sungir (56° 10' N, 40° 30' E) confirm the presence of complex clothing (Bader 1978; Bader 1998) and also the adornment of garments with beads (Fig. 2). More than 10 000 beads made from mammoth tusk ivory were recovered during excavations between 1957 and 1977. Red ochre was abundant, especially around the crania. The distribution patterns of the beads indicate that the people of Sungir wore shirts with sleeves, trousers, footwear, and head coverings, and also outer cloak-like garments (i.e. fitted garments, with multiple layers). The beads were probably strung on animal sinews, and these decorative strings were then sewn onto garments. In addition to beads, other decorative artefacts found at Sungir include drilled Arctic fox canine teeth, stone pendants, rings on some of the fingers, and bracelets made from thin plates of mammoth tusk ivory. The significance of the Sungir burials lies not only in the unique archaeological evidence for the use of complex clothing as thermal insulation from cold temperatures and wind chill in middle latitudes during the latter part of the last glacial cycle. The remarkable numbers and patterns of beads – together with other decorative artefacts such as Arctic fox canines – indicate that by c. 34 000 cal BP, clothing had begun to inherit important social functions associated with adorning the human body, functions which hitherto

**Fig. 3 (right page)** The main transitions in clothing, from *ad hoc* to routine use and from simple (loose) to complex (fitted and/or layered) garments, together with the acquisition of decorative and symbolic functions. These transitions occurred within an environmental context of intensified global climate change, associated with temperature fluctuations of increasing magnitude.

***Abb. 3 (rechte Seite)*** *Darstellung der wichtigsten Übergänge in der Geschichte der Bekleidung, von* ad hoc *genutzter bis zur Alltagskleidung und von einfacher (lockerer) zu komplexer (anliegender und/oder mehrlagiger) Kleidung, zusammen mit dem Erwerb dekorativer und symbolischer Funktionen. Diese Übergänge erfolgten in einem Umweltkontext mit verstärktem globalen Klimawandel, der mit zunehmenden Temperaturschwankungen verbunden war.*

4 Hoffecker 2017; Pitulko et al. 2012; Pitulko/Pavlova 2019; Fedorchenko/Belousova 2021.

5 Bader 1978; Bader 1998; Alekseeva/Bader 2000; Nalawade-Chavan et al. 2014; Trinkaus et al. 2014; Trinkaus/Buzhilova 2018; Kuzmin et al. 2022.


Africa
textile clothes
eyed needles
bone awls
age (years)
500 000
150 000
100 000
50 000
0
Asia
textile clothes
eyed needles
bone awls
age (years)
500 000
150 000
100 000
50 000
0
Europe
textile clothes
eyed needles
bone awls
age (years)
500 000
150 000
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Australia
textile clothes
eyed needles
bone awls
age (years)
500 000
150 000
100 000
50 000
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Americas
textile clothes
eyed needles
bone awls
age (years)
500 000
150 000
100 000
50 000
0
Clothing evolution
decorated
multi-layered
fitted
simple
age (years)
500 000
150 000
100 000
50 000
0
F. d'Errico
41 kyr cycle
100 kyr cycle
Equivalent Vostok ΔT (°C)
δ18O Benthic Carbonate (per mil)
Five Million Years of
Climate Change from Sediment Cores
Millions of Years Ago

**Fig. 4** Artist's impression of decorated complex clothing in the Upper Palaeolithic, based largely on the Sungir findings.

***Abb. 4*** *Künstlerische Darstellung von verzierter, komplexer Bekleidung aus dem Jungpaläolithikum, weitgehend basierend auf den Funden von Sungir.*

had been served by decorating the unclad body. In other words, Sungir confirms the transition to clothing as dress.

## Clothing as dress

The evolution of clothing began as a technological adaptation to global climate change, mainly among hominins residing in cooler regions. Simple garments were utilised on a utilitarian basis, starting from at least the Middle Pleistocene, progressing to complex clothing assemblages (fitted garments, and then multiple layers) for physiological reasons during the Late Pleistocene (Fig. 3). The next major development with Palaeolithic clothing occurred specifically with complex clothing, when the social and psychological functions traditionally served by decorating the human body began to be transferred from the human skin surface onto the surface of clothes.

Despite the archaeological invisibility of clothing per se in the Palaeolithic era, the merging of two purposes for clothing – insulation and decoration – is corroborated by archaeological evidence in the Late Pleistocene, notably at Sungir. Upper Palaeolithic clothing combined sophisticated thermal protection with increasingly elaborate adornment for social purposes (Fig. 4). The latter function – adornment – was subsequently to become more important than the original function of clothing, effectively decoupling clothing from climate. This functional transition was responsible for the postglacial persistence of clothing. Woven textiles replaced animal hides and furs as preferred materials for clothes in the warmer and more humid environments. Furthermore, a demand for fibres – wool, cotton, flax, and hemp, among other natural fibres – may have augmented food production as an impetus for transitioning from hunter-gatherer to agricultural economies. The rest is history. Specifically, the historical era has witnessed a global expansion of populations and cultures where clothing comprises the most prominent form of dress.

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2 K. N. Nikahristo, O. N. Bader Archive, Institute of Archeology of the Russian Academy of Sciences
3 Modified after Gilligan et al. 2024, 8 Fig. 6. Clothing charts by F. d'Errico; temperature chart from Brunetti/Prodi 2015, 7 Fig. 7, reproduced under CC BY 4.0 License
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# Beyond dress, protection, and disguise: Re-inserting animals into the deep history of human clothing

Shumon T. Hussain

**Zusammenfassung**

Jenseits von Mode, Schutz und Verkleidung: Ein Plädoyer für die Neuverortung von Tieren in der Geschichte früher menschlicher Kleidungspraktiken

*Kleidung wird routinemäßig als ein wesentlicher Bestandteil dessen gewertet, was uns zu Menschen macht. Es wird daher immer wieder behauptet, dass das Nachzeichnen der Ursprünge und Entwicklung von Kleidung von entscheidender Bedeutung für das Verständnis der menschlichen Geschichte ist. Es überrascht daher nicht, dass auch Archäologen damit begonnen haben, dieses Problem neu zu überdenken. Der vorliegende Beitrag trägt zu dieser Debatte bei, indem er die Aufmerksamkeit auf konzeptionelle Architektur archäologischer Ansätze lenkt, die sich zum Ziel gemacht haben, die frühe Geschichte der Kleidung in der menschlichen Abstammungslinie aufzudecken, insbesondere ihre vielen unerkannten Einschreibungen, Bindungen und Zwänge. Der Beitrag hebt dabei einen merkwürdigen, aber hartnäckigen blinden Fleck dieser tiefenzeitlichen Forschung hervor: ihre fast ausschließliche Fokussierung auf menschliche (Arten-)Inseln, die entweder von äußeren Naturkräften wie dem Klima beeinflusst werden oder sich selbst (und nur sich selbst) von innen heraus beeinflussen. Der Autor argumentiert, dass dies paradoxerweise dazu geführt hat, dass die vielfältigen Beziehungen zwischen Menschen und Nicht-Menschen – die möglicherweise in frühe Bekleidungspraktiken eingeschrieben sind und durch diese ausgehandelt werden – von der Forschung weitgehend ausgeklammert worden sind, und das, obwohl die frühesten Beispiele menschlicher Kleidung oft stark auf tierische Materialien rekurrieren. Im ersten Schritt der Analyse werden zunächst die Hauptstränge der tiefenzeitlichen Erforschung der Kleidung nachgezeichnet und gezeigt, dass deren Logik auf dem Gegensatz von Kleidung und Nacktheit mit Wurzeln im Europa des 19. Jhs. beruht, welcher nicht nur von einem unaufgelösten Anthropatriarchat durchdrungen ist, sondern auch von kolonialen Tropen der Minimalbekleidung, Animalität, Klimasensibilität und Naturtranszendenz durchsetzt ist. Im zweiten Teil des Beitrags werden die konzeptionellen Abkömmlinge dieser Forschungslogik – die Thermoregulationshypothese, die Polarität von Bedeckung und Mode sowie die Dichotomisierung von (Jagd-)Verkleidung und Ritual – kulturübergreifenden und Indigenen Belegen für ein Interesse an der Übernahme von nicht-menschlichen Körpern und Körperteilen gegenübergestellt. Dies soll die empirischen Möglichkeiten veranschaulichen, die sich aus der Auflösung vorherrschender, aber zunehmend problematischer Vorannahmen in der Archäologie der Kleidung ergeben.*

**Schlagwörter** Human evolution, Nacktheit, Animalität, Mensch-Tier-Beziehung, Epistemologie

**Summary**

*Clothing is routinely portrayed as a key ingredient of what makes us human. Tracing its origins and evolution is therefore argued to be of critical importance for understanding the human story, and archaeologists have unsurprisingly started to reconsider this problem. This paper joins the debate by drawing attention to the conceptual architecture of archaeological approaches dedicated to uncovering the deep history of clothing in the human lineage, notably its many unrecognized binds and constrictions. It highlights a curious yet persistent blind spot of such deep-time research: its near-exclusive preoccupation with human (species) islands, which are either affected by external natural forces such as climate or affect themselves (and only themselves) from within. I argue that, paradoxically, this has put diverse human-nonhuman relations – possibly inscribed in and negotiated by early clothing practices – outside the brackets of research, and this even though the earliest examples of human clothing often rely heavily on animal materials. I first offer a conceptual analysis of the main strands of deep-time clothing research, showing that its logic hinges on the 19$^{th}$-century European opposition between clothing and nakedness not only infused with much-unresolved anthropatriarchy but also obsessed with colonial tropes of minimum clothing, animality, climate sensibility and nature transcendence. In the second part of the paper, I then contrast the conceptual offspring of this research logic – the thermoregulation hypothesis, the cover-dress and the (hunting) disguise-ritual polarities – with cross-cultural and Indigenous evidence for a fundamental concern to take on other-than-human bodies and body parts to illustrate the empirical opportunities that emerge from dissolving these long-standing but increasingly problematic presuppositions in the archaeology of clothing.*

**Keywords** Human evolution, nakedness, animality, human-animal relations, epistemology

## Heracles, Neanderthals and The Evolution of Human Clothing

Clothing is often positioned as a human-exclusive practice, even though charismatic megafauna such as orcas and elephants regularly receive social media attention for ostensibly arranging other animal- or plant-based headgear[1]. Still, humans are regarded as the only animals who consistently wear clothes, purposefully alter, modify or redress their bodies, and have integrated such behaviours into their varied societies and cultures across history[2]; clothing is viewed as an evolved, species-level characteristic of *Homo sapiens* and often treated as part and parcel of its ›extended phenotype‹ (*sensu* Dawkins 2016 [1982]). Yet clothing is also and has always been a key ingredient of what may be termed the Western ›prehistoric imagination‹[3]. As such, it is deeply entangled with 19th-century European ideas and preoccupations shaped by the nascent modern period (modernity in historical terms), nation states, imperialism, colonialism, and the rise of science as a counter-project to Indigenous knowledge[4].

Narratives and concepts relating to the evolution of clothing are firmly inscribed into human-animal boundary policing[5] and remain interwoven with the complex legacy of D. Morris' (1994 [1967]) influential ›The Naked Ape‹ and allied renderings of a functional co-evolution of human nakedness and clothing. D. Morris' perspective is not only ripe with anthropatriachy (*sens*u Narayanan 2019) as it ›leaked erotic fantasy‹ and uncritically (and deliberately so) ›established the heterosexual couple as the end [and goal] of evolutionary history‹ (Geroulanos 2024, 354)[6]; it also excessively indulged C. Darwin's (2023 [1871]) obsession with sexual selection as the principal mechanism of human evolution[7]. Clothing, along with other allegedly ›aestheticized‹ practices such as music or song (cf. Menninghaus 2011), was therefore quickly exiled to the realms of self-domestication and courtship, with clothing unavoidably becoming one of the stereotypes of human ›extra-somatic adaptation‹[8] and reproductive ›costly signalling‹ (Kuhn 2014) – in the wake of anthropologists such as N. Chagnon (1983 [1968]) stained with irredeemable competition, violence and (male) antagonism[9].

Clothing in this broader context emerged as an important designator of the human epic: to escape the shackles of the natural world and to overpower human biological limitations by cultural technology. Potent 19th and 20th-century philosophical ideas of the ›indeterminate‹ or ›incomplete‹ animal with influences from F. Nietzsche to A. Gehlen (1988 [1940]) fuelled these ideas from early on as the human-characteristic ›gap‹ in adaptive fit between biology and environment could be chiefly closed by developing a ›second skin‹ to shield against adverse externalities – the thermoregulation hypothesis for the origin of clothing was born[10]. Moreover, after the 1950 publication of K. Oakley's ›Man the Tool-Maker‹ (1976 [1950]), scholarship increasingly identified technology that helped to compensate for the biological insufficiencies of early humans as interceding somewhere *between* nature and culture (Geroulanos 2024, 335). This opened the gates to explicitly frame clothing – just as stone tools had been – as an evolutionary stepping-stone to unfolding human cultural diversity: the foundational idea that clothing developed as a biological necessity and then provided some of the key resources for elevated rates of cultural evolution. As I write this, the latest research on the deep-time trajectory of clothing practices across Africa and Eurasia confidently reproduces this broader narrative framing, identifying ›complex‹ clothing – i.e. multi-part and multi-layered garments and costumes – as the landmark development at the juncture between human nature and culture, from signifying merely extended biological bodies to enshrining fully developed cultural bodies (Gilligan et al. 2024). Thus, the distinction between ›cover‹ and ›dress‹ is born (Gilligan 2023), risking not only the reification of Western nature-culture binaries and attendant fantasies of heroic nature subjugation as universal when they are historical products themselves (Descola 2005; Palsson 2017), but also viewing clothing's cultural significance in human evolution through the anachronistic lens of fashion culture and *haute couture* – both distinctive phenomena of European modernity.

Returning to the imagination of prehistory, ›nakedness‹ was both a trope in early illustrations of Pleistocene hominins, especially after Darwin in the early 20th century (Moser 1998; Coste 2015), and the portrayal of Indigenous people (e.g. Dransart 2013; cf. Geroulanos 2024, Chapter 8) – and this is no mere coincidence. Nakedness was associated with ›incompleteness‹ (in terms of evolutionary stage and development) and thus readily taken as evidence for animal proximity, wildness and primitivism. A powerful expression of the early renderings of such people as ›ape-human‹ is the loincloth, which is often the only body cover shown in early hominin illustrations; it stands exemplary for the diagnosed *minimum* of clothing[11], placing its wearers somewhere between nature and culture and hence as not-fully-human-yet.

1 Orcas have been observed balancing dead salmon on their heads (e.g. <https://www.livescience.com/animals/orcas/orcas-start-wearing-dead-salmon-hats-again-after-ditching-the-trend-for-37-years> [24.03.2025]) and African elephants are reported to cover themselves with grass hats/mats (e.g. <https://www.reddit.com/r/AnimalsBeingDerps/comments/s5o0fd/baby_elephant_gives_himself_a_grass_hat/?rdt=49014> [24.03.2025]).

2 See esp. Gilligan 2019; Davies 2020; Nowell/Cook 2021; d'Errico 2024.

3 See Stavrinaki 2022; Geroulanos 2024 for a careful dissection of some of the more salient tropes.

4 Ironically strongly supported, and not undermined, by the missionary agendas of state-powered Christianity operating *inter alia in* the ›New World‹.

5 The obsession to establish differentia specifica: see esp. R. Corbey 2005 for the broader context of this debate.

6 Cf. esp. E. Illouz 2012 for a sociological account for why this view is a capitalist anachronism.

7 See S. Geroulanos 2024, Chapter 5 for the entanglement of this view with 19th-century notions of human exceptionalism as well as infusions of theology.

8 Binford 1962, 218; cf. Kelly 2019 for the continued centrality of this notion.

9 This view is still current and lives on in some of the most recent accounts, see e.g. Gilligan 2024.

10 See e.g. Gilligan 2007; Gilligan 2010; Gilligan 2019; Wales 2012 for notable contemporary examples.

11 For many ironically reinforcing the sexual selection hypothesis and the Christian theological idea of ›shame‹ as an ur-motif of the same.

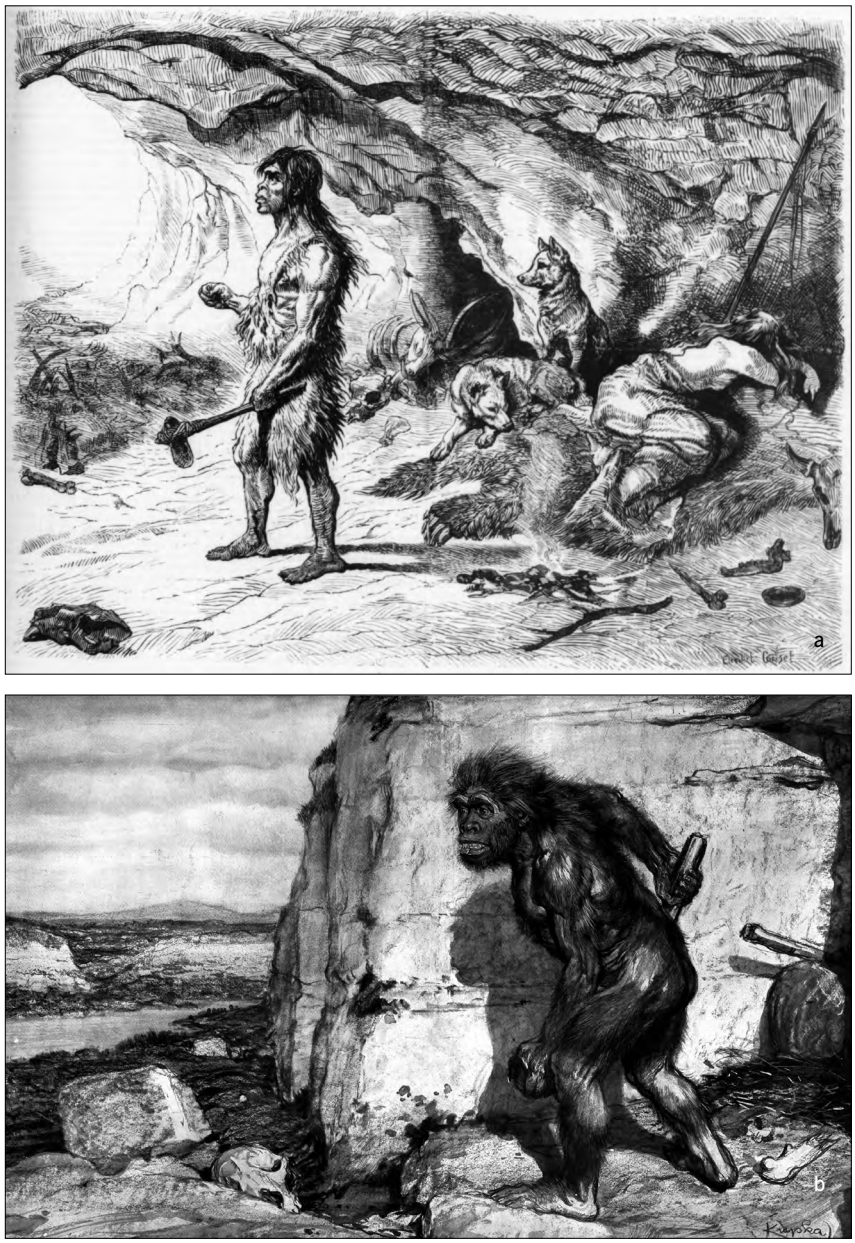


**Fig. 1a–b** Two contrasting visions of Neanderthal clothing at the turn of the century. a Anonymous Neanderthal reconstruction from an 1873 issue of ›Harper's Weekly‹, a political journal obsessed with ideas of civilisation, showing the prototypical Neanderthal as savage with romantic undertones. b La Chapelle-aux-Saints Neanderthal reconstruction created by primitivist painter František Kupka and published in the ›Illustrated London News‹ in 1909. Note that the latter was heavily influenced by French palaeoanthropologist Marcel Boule's notion of Neanderthals as ›subhuman‹ and ›extirpated‹ by superior *Homo sapiens* populations, associated with Darwinian readings of their backwardness as apish (closer to ape than human) reflected in their posture and hair cover.

***Abb. 1a–b*** *Zwei gegensätzliche Visionen von Neandertaler-Kleidung zur Jahrhundertwende. a Anonyme Neandertaler-Rekonstruktion aus einer Ausgabe von »Harper's Weekly« von 1873, einer politischen Zeitschrift, die von zivilisatorischen Ideen durchsetzt war und den prototypischen Neandertaler als Wilden mit romantischen Untertönen zeigt. b Die Neandertaler-Rekonstruktion von La Chapelle-aux-Saints des primitivistischen Malers František Kupka, veröffentlicht in der »Illustrated London News« im Jahr 1909. Bei dieser Rekonstruktion ist zu beachten, dass diese stark von der Auffassung des französischen Paläoanthropologen Marcel Boule beeinflusst war, der die Neandertaler als »untermenschlich« einstufte und postulierte, dass diese von den überlegenen* Homo sapiens*-Populationen »ausgerottet« wurden, was mit der darwinistischen Lesart ihrer Rückständigkeit als affenartig (näher am Affen als am Menschen) zusammenhing, die sich in der Haltung und Haarpracht der Neandertaler widerspiegelt.*

It is noteworthy that hominin illustrations pre-dating C. Darwin's (2023 [1871]) ›Descent of Man‹ and thus devised under the impression of European romanticism (peaking from c. 1800 to 1850) often differ notably from post-Descent representations: they more eagerly depict early hominins as partially clothed, while early 20th century illustrations typically juxtapose pronounced hairiness with minimal clothing (especially pre-*Sapiens* hominins), either combined or as polar opposites (Fig. 1; Geroulanos 2024, 137–151). Clothing – understood literally as the concealment or domestication of the ›animal-within‹ – here figures as a potent image of the ›thin veneer‹, a civilisatory trope of the time. According to veneer theorists, human beastly nature could only be conquered momentarily (and never completely) by the outer shell provided by civilisation – its practices, morales and technologies (see esp. Geroulanos 2024, Chapter 9). However, colonial logic also inspired ›scientific‹ inquiry into the potential bodily insensibilities of so-called ›primitive‹ people as it was reasoned that they might withstand severe climates more easily than ›civilised Man [sic!]‹; for example, the late 19th-century P. Hyades conducted experiments (using a device called the Weber compass) in the Southern Hemisphere at Tierra del Fuego (Argentina) to establish whether the local Yaghan people exhibited a ›greater threshold of sensibility than Europeans‹ (Dransart 2013, 191; cf. Dias 2007).

These experiments were motivated by what was judged ›minimal‹ body coverage, yet the discourses in which they were embedded also showcase, as P. Dransart (2013) has proficiently exposed, a fundamental misunderstanding of Indigenous clothing, which often included practices such as coating one's body with seal and whale oil (offering notable environmental protection), which European observers did not take into account, mainly because they employed European clothing standards. The gradual replacement of traditional clothing systems centred on the zoomaterial-

**Fig. 2** Charles R. Knight, ›Neanderthal Flintworkers‹, Le Moustier cavern, Dep. Dordogne (France; 1920). Mural of a Neanderthal family overlooking a Pleistocene river valley with the central figure wearing a conspicuous loincloth, displayed in the American Museum of Natural History, New York City, stair hall, Section 2A.

***Abb. 2*** *Charles R. Knight, »Neanderthal Flintworkers«, Le Moustier cavern, Dép. Dordogne (Frankreich; 920). Wandgemälde einer Neandertalerfamilie, die ein pleistozänes Flusstal überblickt. Die zentrale Figur trägt einen auffälligen Lendenschurz, ausgestellt im American Museum of Natural History Museum, New York City, Treppenhalle, Abteilung 2A.*

ity of key animal others in the environment with European-style clothing may even have been causally implicated in the post-contact demographic decline of Indigenous people in the region (Dransart 2013). Even so, contemporary scholarship has uncritically retained the proposition of reduced climate sensibility, asserting that the Tierra del Fuego people ›were able to withstand inclement weather and tolerate significant changes in the temperature without being significantly discomfited‹ and are consequently less reliant on clothing (Delaney 2017, 297). The difficulty of avoiding racial stereotypes while recognizing the possibility of varied consequences of biocultural coevolution (including perceptions of warmth) continues to haunt modern archaeology: for example, R. Hosfield (2017), in response to I. Gilligan's (2017, 534–535) injunction of ›safe naked limits‹, rightly insists that ›we must be cautious in applying modern human tolerances to Lower Palaeolithic hominins, given the possibility of physiological differences such as body hair coverage or other adaptations‹.

Another interesting detail concerns the kind of pelt cover associated with the ›strategic half-naked[ness]‹ of early hominins, of which American palaeoartist C. R. Knight's ›Neanderthal Flintworkers‹ (1920) is a lucid example (Fig. 2; Geroulanos 2024, 142). The drawing's central figure – a Neanderthal of southwestern France – is placed against the background of a rock shelter and Ice Age elements, holds only some (ostensibly basic, ›primitive‹) tools, notably a spear and a crude stone, and wears a ›bundled leopard rag‹ (Geroulanos 2024, 142). Why the leopard[12]? The archaeological evidence from Le Moustier that the Neanderthal visualization is supposedly referencing is clearly not the source of the inspiration (there were no leopards there) – instead, it is the Hellenistic story of Heracles.

To understand the invocation of the leopard, we need to briefly consider Knight's well-researched entanglement with H. F. Osborn, the first curator of the vertebrate palaeontology department of the American Museum of Natural History in New York – a man of eugenic leanings and with a racial politics agenda centred on the belief that the deep past would help to identify the origins of contemporary human ›races‹ (Sommer 2016, Chapter 3), and, in Osborn's own words, to characterise their ›race plasms‹ as well as their ›racial lines‹ (Sommer 2010, 474). H. F. Osborn had recruited Knight to paint various murals for his new ›Hall of the Age of Man‹, through which his prehistoric agenda was to be promoted and popularised. He was obsessed with the idea that ›Cro-Magnon man‹ was gracile, artistic and ultimately of Caucasian affinity, while Neanderthals were savage brutes of non-Western pedigree. H. F. Osborn also greatly admired ›cats (of prey)‹ (Sommer 2010, 475). C. R. Knight specifically consulted H. Breuil – the great French prehistorian of his time – about the nature of prehistoric clothing; although H. Breuil symptomatically reasoned that Ice Age people likely wore no clothes at all, H. F. Osborn insisted some clothing to be presented for the sake of modesty (Clary 2022, 50). The ›bundled leopard rag‹ portrayed in ›Neanderthal Flintworkers‹ is thereby likely a tacit reflection of the same implicit Orientalism which had entered European art from the 18th century on and which regularly promoted Eastern racial stereotypes by means of people clothed in leopard skins (e.g. see Moberly 2020). This is consistent not only with H. F. Osborn's idea of Neanderthal Asian origins, which C. R. Knight accepted (Clary 2022, 57), but also supported by C. R. Knight's recurrent portrayal of Neanderthals as contesting with large predators, for example in a painting of a Neanderthal man defending his family against wolves, non-coincidentally wearing a conspicuously similar (leopard) rag[13], and other artwork in which Neanderthals are stalked or overwhelmed by large cats, driving home H. F. Osborn's and C. R. Knight's shared understanding of Neanderthals as not (yet) freed from the shackles of natural predation and warfare[14]. As such, the leopard reference appears to be deeply embedded in the cultural imagination of its time, loaded with Eurocentrism and

12 I thank O. Jöris, LEIZA, for alerting me to the general possibility of the rag being a hyena hide rather than that of a large feline. As far as I can see, however, there is no historical evidence or indication that C. R. Knight or H. F. Osborn paid any attention to, were concerned with, or interested in hyenas or hominin-hyena relations – on the contrary. All evidence, in line with broader themes and preoccupations of their contemporaries, suggests they were captivated by large exotic cats including leopards and jaguars (see next paragraph for some elaboration).

13 <http://www.charlesrknight.com/Prehistoric.htm> (25.03.2025).

14 For the role of the concept of ›natural warfare‹ in discussions on the supposed state of nature, see notably S. Geroulanos 2024, Chapter 3.

**Fig. 3** Peter Paul Rubens, ›Heracles and the Nemea Lion‹ (between 1600 and 1640). Heracles, standing over a defeated leopard, fights the Nemean Lion. The ›struggle‹ is symmetrical and occurs in the ›wild‹ (a cave), far outside the walls of the civilised city. Oil painting, National Museum of Art of Romania, Bucharest.

***Abb. 3*** *Peter Paul Rubens, »Herkules und der Nemeische Löwe« (zwischen 1600 und 1640). Herkules, über einem besiegten Leoparden stehend, kämpft gegen den Nemeischen Löwen. Der »Kampf« ist symmetrisch und findet in der »Wildnis« (einer Höhle) statt, weit außerhalb der Mauern der zivilisierten Stadt. Ölgemälde, Nationales Museum für Kunst in Rumänien, Bukarest.*

much explicit racism; it illustrates how paintings such as ›Neanderthal Flintworkers‹ were shaped by the intellectual and political preoccupations of their era.

The image of the leopard is multi-layered and rich in Western symbology and allegory: in the classical world of the ancient Greeks, the animal was associated with ›the wild cult of the sensuous deity Dionysus‹, the god of ›wine and drunkenness, of chaotic sexual pleasure, of lavish partying and ecstasy‹ (Morris 2014, 25). Dionysus was not only frequently depicted as wearing leopard skin himself, but he was also sometimes shown as riding a leopard. This enmeshment of Dionysus and the leopard is no accident. Dionysus embodies ›savage nature‹ and the ›primal forces that lie outside of the restraints of civilised city, and his companions the leopards [and their ›wild carnality‹] epitomise this‹ (Morris 2014, 26). This general logic also dominates Roman imaginaries in which Dionysus became Bacchus, often depicted as a drunken, naked child riding a leopard or feeding leopards. Within the blood-soaked spectacle of the Colosseum, leopards and other felines brought the brutality of undomesticated nature into the heart of the civilised world and helped to reproduce this world through the agency of gladiators and captives alike as part of the great ordeal of civilisation. Here, the leopard effectively functions as a nonhuman mediator between nature and culture: a feline staircase of sorts that facilitates the transition from ›savage‹ to ›civilised‹. Again, the juxtaposition of naked and minimally clothed (in feline skin) is a key trope.

The basic topos also governs the Heracles narration, whom J. Dunn (2004) symptomatically qualifies as an ›uncivilised civiliser‹ – a duality not only echoing Heracles' hybrid human-god origin but also resonating in his deeds to secure civilization's triumph over savage nature. In particular, this is revealed in relation to his quest to overcome the Nemean Lion, whose pelt he wears as a cloak and whose jaws he fashions into a helmet to impersonate the accomplishment (cf. Rodríguez 2010, 256). Importantly, though, Heracles neither truly *belongs* to the beastly or human realms nor to the noble, godly realms; his deeds merely grant him salvation from his irreducible in-betweenness, which is simultaneously a curse and boon. This is the rapprochement between Heracles and the Neanderthals of south-western France that C. R. Knight's illustration accentuates.

The Heracles story also illustrates another preoccupation of Eurasian axial thought[15]: The idea that to contain and prevail in the face of savage nature and the uncivilised

15 The culmination of the Axial Age, see esp. Jaspers 2017 [1950]; Assmann 2018.

**Fig. 4** Screenshot of Alexander the Great on his horse Bucephalas amid the Battle of Gaugamela (331 BC), confronting the great Persian army under the leadership of King Darius III. near modern-day Erbil, northeastern Iraq. From the motion picture ›Alexander‹ (2004) directed by Oliver Stone. Note the leopard skin draped over Bucephalas' saddle. In the movie, Alexander styles himself as the ›son of the gods‹ and explicitly places himself in the great lineage of Heracles, the maker of civilisation. Again, the leopard represents the tremendous civilisatory ordeal (of the Greeks) to overcome the (savage) foes from the steppes (the Persians), ultimately giving birth to the superior Hellenistic world.

***Abb. 4*** *Screenshot von Alexander dem Großen auf seinem Pferd Bucephalas inmitten der Schlacht von Gaugamela (331 v. Chr.), als er dem großen persischen Heer unter der Führung von König Darius III. in der Nähe des heutigen Erbil im Nordosten des Irak gegenübersteht. Aus dem Film »Alexander« (2004) unter der Regie von Oliver Stone. Zu beachten ist das Leopardenfell, das über Bucephalas' Sattel drapiert ist. Im Film bezeichnet sich Alexander als »Sohn der Götter« und stellt sich ausdrücklich in eine Linie mit Herakles, dem Erschaffer der Zivilisation. Auch hier steht der Leopard für die große zivilisatorische Anstrengung (der Griechen), die (wilden) Feinde aus der Steppe (die Perser) zu besiegen und schließlich die überlegene hellenistische Welt zu schaffen.*

world writ large, civilisation needs to release and cultivate its own beasts to match those of nature (Fig. 3). This is sometimes explicitly styled as a quasi-eternal contest of the civilised against the rest. The basic idea is already a key feature of the Assyrian and Egyptian royal lion hunt: rulers styled themselves as ›raging lions‹ and ritually confronted and killed other wild lions as part of their royal duty (Fig. 4; see, e.g. Wagner-Durand 2019, 245). As G. Selz (2001) has shown, the capable ruler asserted himself as the procreative and ideal protector from the wild, the war hero and the archetypical cosmopoeitic hunter. The lion hunt thereby exemplifies and legitimises an ideology of violence and war to repel enemies and the need to emerge victorious from the ongoing struggle of nature and culture. The royal hunter enacts the hero required to protect ›civilization against the wilds of the steppe‹ (Wagner-Durand 2019, 245), for which the equally ›royal‹ feline others are surrogates.

C. R. Knight's ›Neanderthal Flintworkers‹, in the end, are just that: half-naked beings caught-in-between wild, savage nature and civilisation, properly belonging to neither. They are the tragic Heraclean heroes of the human story, heralding human ascension to civilisation but never truly reaching (or fully possessing) it. Here again, clothing is depicted as a technology of hominisation (the process of becoming a ›complete‹ human) and a representational device to belabour the predicated nature-culture strife and the premised imperative of nature transcendence. In the second part of this contribution, I argue that it need be neither of the two and archaeological discourse would be well-advised to critically plough through this all-too-powerful axial bind.

In addition, and perhaps more importantly, Anglo-European discourse as, exemplified by some of the snippets invoked above, firmly rests on the presupposition that clothing is not only a largely human-exclusive practice – as a part of the package of *Sapiens*-making behaviours – it is also exclusively *for* and *about* humans. There are various ways of specifying this implicit claim, and different scholars have certainly taken varying views, but we may broadly say that the cultural agency of clothing has mainly been understood as an intra-human affair, thought to be all about the participation of clothing in human-dedicated processes such as style, ritual, warfare and the pantheon of human symbols and beliefs and/or how humans come to relate to other humans (e.g. identity, social status, gender, dis-

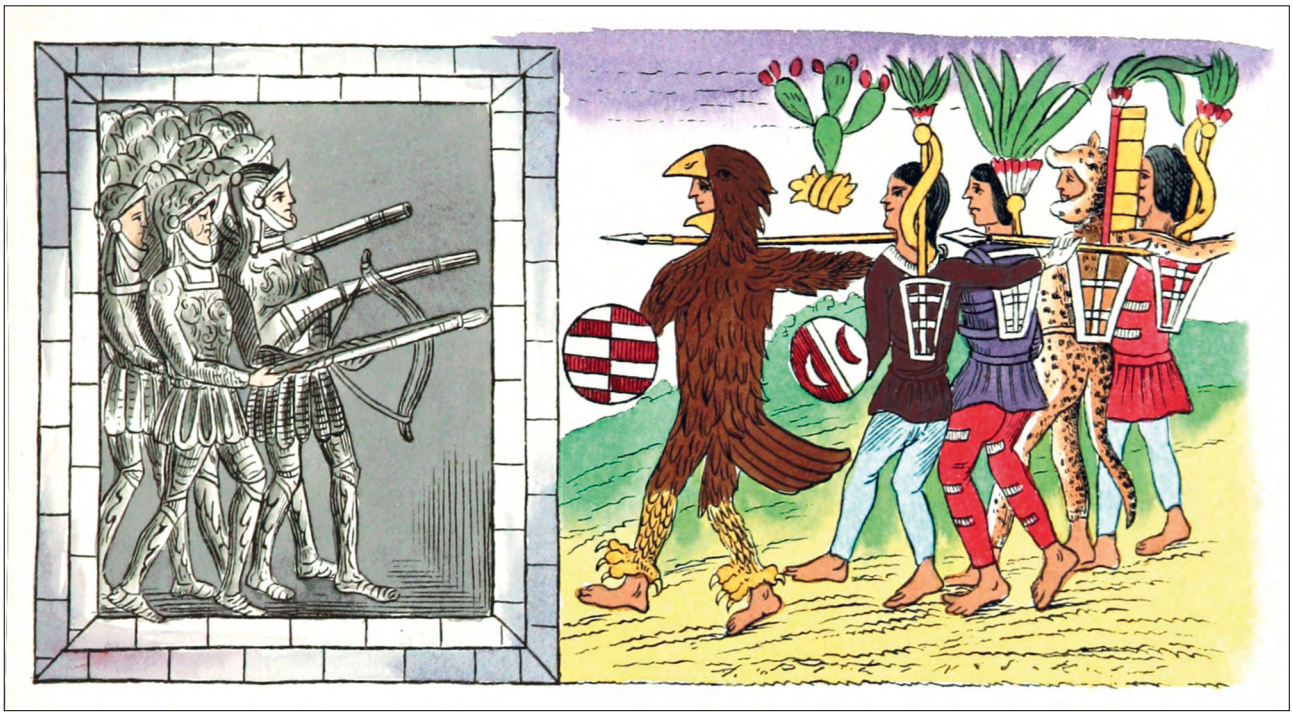

**Fig. 5** Diego Durán, Codex Duran (*Códice Durán* or *Historia de las Indias de Nueva España e Islas de Tierra Firme*; probably 2nd half of the 16th century). The painted scene shows the company of Pedro de Alvarado, companion-at-arms of Hernando Cortes, besieged by Aztec warriors. Note especially the portrayal of eagle and jaguar ›second skin‹ as utilized in Aztec warfare. National Library of Madrid.

***Abb. 5*** *Diego Durán, Codex Duran* (Códice Durán *oder* Historia de las Indias de Nueva España e Islas de Tierra Firme; *wahrscheinlich 2. Hälfte des 16. Jhs.*). *Die gemalte Szene zeigt die Gesellschaft von Pedro de Alvarado, dem Waffengefährten von Hernando Cortes, die von aztekischen Kriegern belagert wird. Zu beachten ist insbesondere die Darstellung der »zweiten Haut« von Adler und Jaguar, wie sie in der aztekischen Kriegsführung verwendet wurden. Nationalbibliothek von Madrid.*

play, etc.). This construal not only overlooks that it is not uncommon for people in non-Western societies to explicitly ›dress up‹ for diverse nonhuman, often supernatural, beings and that the production and deployment of clothing sometimes deliberately targets other-than-human beings including animals, but it also reproduces the problematic yet widespread stereotype of ›species islands‹ as the relevant (or at least most relevant) contexts of clothing behaviour. In sharp contrast, Offering Cache 125 associated with the Tlaltecuhtli monolith unearthed from the main temple complex of the ancient Mesoamerican city of Tenochtitlan yielded not only a ›richly dressed canid‹ surrounded by a group of large ›sacrificial‹ flint knives themselves dressed in costumes and divine insignia, but also, found in the depositional layer immediately below them, two large golden eagles – male and female – clothed in ›ornate attire‹ (López Luján et al. 2015; cf. Bassett 2018, 7). Contemporary pet cultures equally do not shy away from mobilizing elaborate and functionally overdetermined clothes for animals, and the work these animal dresses do clearly transcends the function-representation binary. Modern pet dress of such type often aims to draw pet and owner closer together, tampering with the bodily presence of the respective pets in the hope of *anthropomorphising* them. In the following section, I develop a cross-culturally informed framework to shed new light on the origins of human clothing, strategically inflecting modernity's cultural obsessions and suggesting that clothing may have frequently been concerned with *zoomorphising* the human.

## Clothing as Multispecies World-Making: Wearing and Being Animals

Classical and Post-Classical Mesoamerican societies entertained dashing and multiple clothing traditions that immediately drew the attention of European colonisers, who especially noted the animal-vestedness of Mesoamerican dress cultures and marvelled at ›Jaguar‹, ›Eagle‹, and ›Coyote warriors‹ dressed as the respective animals (Fig. 5; e.g. see Carrasco 1995; García-Des Lauriers 2017; Valesey 2021). In the Anglo-European imagination, these animal garments – perceived concomitantly as more akin to extravagant armaments than ordinary attire and as more symbolic than functional instances of human clothing – were readily cast as ›regalia of sacred war‹ (García-Des Lauriers 2017) and were made sense of, above all, in relation to European categories of militarism, notably as expressions of a noble warrior caste reminiscent of Medieval-style European knightly orders *(Ritterorden)*. This association is not innocent (nor is it merely descriptive): although the attribution recognised Aztec and Maya ›warriors‹ as respectable foes on the battlefield with a reputable military ethos and moral code, it also pictured them in light of an age – the ›age of chivalry‹ (c. 12th to mid–15th century) – which the Spanish Conquistadors believed to have left behind as they saw themselves as the heralds of the ›age of discovery‹ and subsequently the ›age of sail‹, and thus ultimately as foreshadowing the dawning of the early modern period (c. 1500–1800 AD; all of these terms are Eurocentric of course); in addition, from

a European vantage point communities of such warriors styled as ›knights‹ appeared to primarily fulfil ideational, spiritual and eleemosynary roles (cf. e.g. Rodríguez Velasco 2010) and their costumes – even though battle-fit – were seen as just another instance of European heraldry tied to different ›coats of arms‹. The emblematic use of animals in this context became especially widespread in Europe during the 15th and early 16th century[16]; in particular, it was a practice indulged in by European nobility, aristocracy and monarchy.

The resulting European construction of the Mesoamerican Other lives on in modern popular culture, for example, in the acclaimed video game ›Age of Empires II: The Conquerors‹, whose manual specifically underlines the analogy between European knights and Aztec Jaguar *(ōcēlōtl)* and Eagle warriors *(cuāutli)*: ›[a]nother rank of Aztec fighter was the Jaguar Warrior, who was more heavily armed and armoured than the Eagle Warrior. Their role was probably to be the heavy infantry of the army and to engage the enemy's main body. They likely had the advantage in combat against lighter troops that were caught off-guard or foolish enough to engage the heavier Jaguar Warrior. These warriors wore jaguar headpieces and clothing that represented jaguar fur. The jaguar was chosen as the totem for warriors because it was the fiercest predator in the Central American jungles.‹ The significance of the jaguar itself is reduced here to a mere symbolic feat, and the confusion, equalisation, and amalgamation of totemism and animal heraldry are diagnostic. As C. Valesey (2021) has recently suggested based on the critical comparison of Spanish and Indigenous Nahuatl sources, Jaguar and Eagle ›warriors‹ as imagined by these accounts probably never existed; becoming jaguar and/or eagle was certainly not an exclusive concern of the elites, but rather a society-wide imperative transcending status and gender, and the reading of their significance as merely ›emblematic‹ is problematic on many levels.

Part of the issue is that eagle and jaguar – both in language and in visual rendering – rarely appear in isolation in Nahuatl contexts, instead denoting a structural coupling or complementary principle – what C. Valesey (2021, 979) captures with the notion *difrasismo*[17]. Moreover, even though the point of deploying these terms as a pair is often pervasively metonymical[18], there is also a degree of ambivalence in what the words eagle and jaguar reference (and hence ›do‹). In the broader context of clothing, notably, referring to eagles and jaguars can, in this way, even explicitly refer to the clothes themselves (cf. León-Portilla 2011, 437). These terms, in other words, may not always pertain to individual people but also to nonhuman entities such as costumes, such that the respective costume itself is addressed *as jaguar* and/or *eagle* (Valesey 2021, 991). The implication is far-reaching: the costume may literally *be* (or act as) a jaguar; it may facilitate literally *becoming* a jaguar or help cultivate the *qualities* jaguars embody and enact. The kind of ›jaguar functionalities‹ lent in this manner by such clothing cannot be understood by invoking the cover-dress binary, nor do they reflect the sort of project implicit in P. Wiessner's (1983, 257) ›emblematic style‹ which remains so central to Anglophone theory-building on the subject: as a ›formal variation of material culture that has a distinct referent and transmits a clear message to a defined target population about conscious affiliation or identity‹. As C. Valesey (2021, 985) puts it, invoking jaguars and eagles in the context of objects such as the Aztec throne or specific (zoo-)material devices attachable to the human body allows ›jaguar and eagle bodies [to] *animate* the objects with the perceived essences of those animals‹ (emphasis added).

Whether the talk of ›essences‹ makes sense in the Nahuatl context remains to be seen, but what matters greatly here is the need to pay more serious attention to clothing as a *transformative practice of the self* and the fact that the integration of animal materiality cannot be reduced to matters of external ›protection‹ or inter-human ›communication‹. In other words, we need to be more heedful of the question of what precisely *happens* when human and animal bodies (or parts thereof) meet and tangle up. That human bodies primarily become protected or that they can serve as a medium of interpersonal communication is just one of the many possible outcomes of interspecies body gatherings. For example, the Yanomami of the north-eastern Amazon at the border of Venezuela and Brazil paint their bodies with dark dots and ovals to mimic the appearance of the outer coats and skins of animals bearing such salient or unusual markings; as P. Descola (2021, 162)[19] notes, a specific goal (or function if you will) of these ›second skins‹ is to enable other animals to see people as a part of their extended collective. He explicitly speaks of ›ontological costuming‹, even if such participation in the target animal collectives can only be temporary. Clothing, just as body painting, is frequently understood not simply as an addition to the body as inert *res extensa* but as part and parcel of the living body – clothing literally *repositions* the body in the world: altering what it can do and what perspectives it can acquire. This is because, for many Indigenous people, there is no distinction between skin and clothing; clothing *is* skin and the other way around, while both are mere envelopes of initially concealed (but often ancestrally shared) interiorities. This is why, in articulating his arguments for a broader Amerindian perspectivism as a sort of inversion of Western Cartesianism, Brazilian anthropologist E. Viveiros de Castro (1998, 470–471) points out: ›[...] animals are people, or see themselves as persons. Such a notion is virtually always associated with the idea that the manifest form of each is a mere envelope (a ›clothing‹) which conceals an internal human form [...]. This internal form is the ›soul‹ or ›spirit‹ of the animal: an intentionality or subjectivity formally identical to human consciousness, materialisable, let us say, in a human bodily schema concealed behind an

16 And thus precisely when Europeans first encountered Mesoamerican dress cultures, see, e.g. Hiltmann 2011.

17 A common grammatical construction in Mesoamerican languages to convey relational signification: see also Purcell 2023, Part I.

18 Words can variously substitute each other and so refer to complex, non-figurative webs of meaning.

19 All pages following the German 2023 translation of the French original.

animal mask‹. Invoking the idea of the ›mask‹ is not coincidental here, as clothing is regularly viewed as yet another way of masking oneself as Other, and just like masking, one purpose is to enact the *agency* of this Other.

Anthropologist P. Descola (2021, 164–165) similarly argues that what in the globalized West is typically rendered as ›dress‹, in many Indigenous contexts merely constitutes a ›physical cover [mantle or shroud] taking the form of a bird, fish, vessel, tree or musical instrument‹ (my translation) and is indistinguishable from the referenced form as people only know their surroundings through engaging with that which ›covers‹. In other words, all other observable entities *are* such covers (Descola 2021, 165). Therefore, varying body types point to the manifold possibilities of becoming, as the diversity of life is primarily a *diversity of bodily form* (interiorities are more similar than the exteriorities given in perception); diversity is about the diversity of being-in-the-world through manifest corporeality and what such corporeality enables one to do, see and know. As such, the body fundamentally intercedes with who people *are*, and changing their bodily cover thus *changes their selves*, even if only temporarily. This is not a question of ›identity‹ as Western scholarly commentators have long maintained, but a question of *being*. The cover-dress binary thus not only grossly misconstrues what may actually be put at stake by different ways of clothing, it also makes it impossible to empirically investigate the relationship between the human body, clothing, zoomateriality and human-animal cohabitation. As P. Descola (2021, 147–174) explores in detail and illuminates with many examples, body types and body parts can be ›loaned‹ and culturally enacted to tap into and temper with the capacities of diverse animal others, to communicate with them, and to generally multiply the human standpoint to navigate the more-than-human world more confidently. This is why fur clothing, for example, often simulates the original anatomy of the mobilised animal body, why, from a Cartesian point of view, dysfunctional body parts such as ears are often retained in such clothing contexts, and why animal body parts such as claws are often used in contexts in which human gestures are thought to be amplified or diversified given what these body parts can do (and human analogies typically cannot do).

To conclude, it is worth recalling C. Conneller's (2004) sharp yet often forgotten arguments for critically reconsidering the ›hunting aids‹ interpretation of the red deer frontlets from early Mesolithic Star Carr, originally advocated by G. Clark. In particular, Conneller takes aim at the underlying recognition of these ›masks‹ as technologies of ›disguise‹ rather than of ›revelation‹ or ›affordance‹. As she rightly points out, narrowing the debate in terms of yet

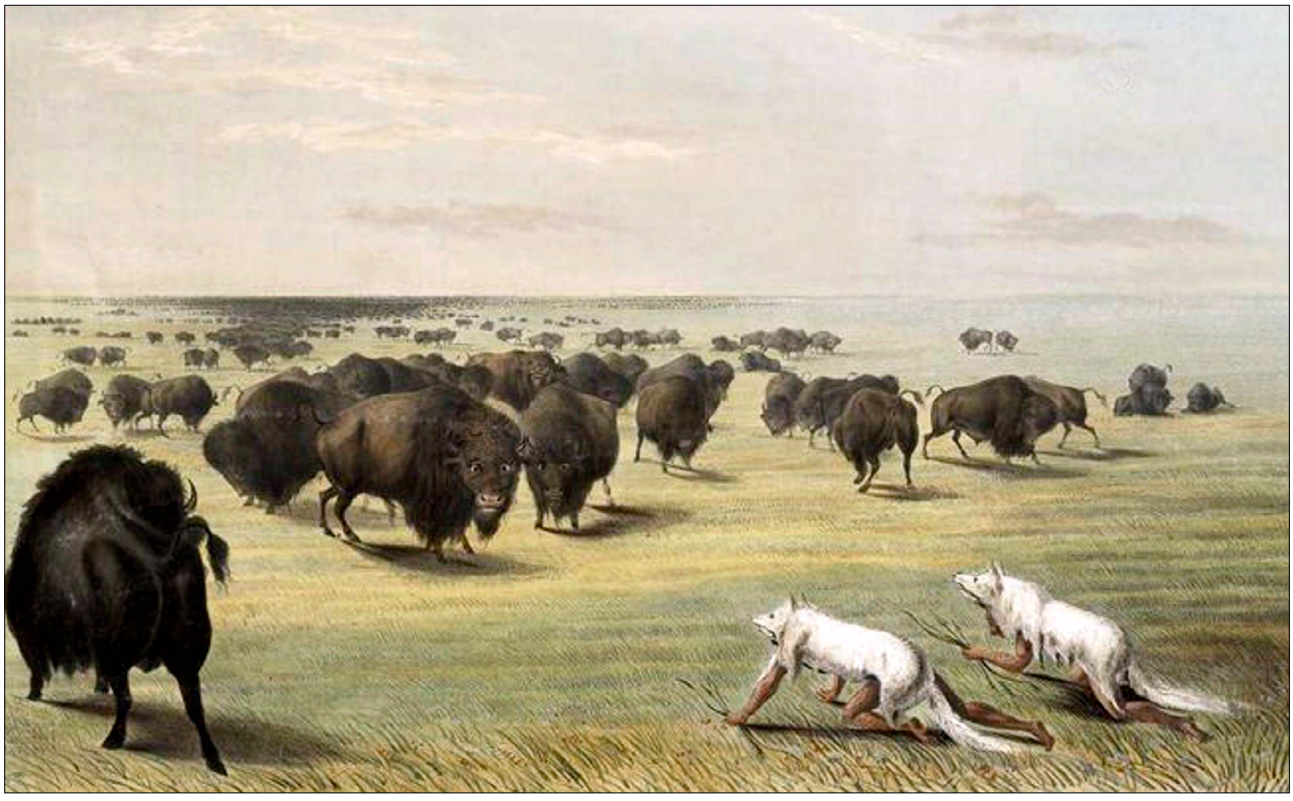

**Fig. 6** Mary Evans, ›Native American Indian Buffalo hunt under the White Wolf Skin. An Indian stratagem on the level prairies‹ (c. 1858). Note the emphasis on ›stratagem‹ (trickery, stealth, deceit), behavioural features regularly deduced from the supposed need of the primitive to survive in open landscapes (such as the Savannah and Prairie) and hence aligning Indigenous North Americans with early hominins. Note also that in these 19th-century discourses, the prairies were cast as an ›uncivilised‹ country, unproductive and resisting the call of civilisation. Museum of the City of New York.

***Abb. 6*** *Mary Evans, »Native American Indian Buffalo hunt under the White Wolf Skin. An Indian stratagem on the level prairies« (um 1858). Beachten Sie die Betonung von »stratagem« (List, Heimlichkeit, Täuschung), Verhaltensmerkmale, die regelmäßig aus dem angeblichen Bedürfnis der Primitiven abgeleitet werden, in offenen Landschaften (wie der Savanne und Prärie) zu überleben, und die somit Indigene Nordamerikaner mit frühen Homininen gleichsetzen. Die Prärie wurde in diesen Diskursen des 19. Jhs. als »unzivilisiertes« Land dargestellt, das unproduktiv ist und sich dem Ruf der Zivilisation widersetzt. Museum of the City of New York.*

another binary[20] greatly inhibits the ability of archaeologists to understand the ›types of [human] body produced from the taking on of objects made from animal remains‹ (Conneller 2004, 37). We simply need to be aware that the boundaries of the body – what a human body even is, how it can be changed and to what effect – is itself a part of the empirical problem posed by archaeological clothing studies, and that many of our assumptions continue to be cloaked in stereotypes of relatively simple hunter-gatherer people (all of these terms are problematic), whose proximity to animals and ambitions towards them reflect their evolutionary closeness to animality.

Late 19th century portrayals of Indigenous North American people covering themselves in wolfskin intended to showcase the inclination of these people to fall back into the animal state in the hopes of increasing their hunting success[21] arguably played an important role in forging this prehistoric imagination of the origins of clothing as disguise (Fig. 6). Yet again, what appears ›self-evident‹ to the contemporary European observer may be fundamentally misleading. In their critical investigation of Indigenous oral history, R. Pierotti and B. R. Fogg (2017) have shown that the early collaborative hunting of humans and wolves is not only a theoretical possibility, but was likely integral to past bison systems. With R. L. Barsh and C. Marlor (2003, 585), we may then suggest that Blackfoot and other Native people ›performed wolves‹ not only to harness their predatory prowess but also to re-enact the multispecies bison-wolf relationship into which they had ›inserted‹ themselves. Clothing makes and breaks specific historically-grown human-animal relationships (it *is* world-making), and as part of such much broader cosmogenic concerns, *zoomorphising* the human body is frequently vital.

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20 ›Disguise‹ vs ›ritual‹, see, e.g. Wild et al. 2020 for the continued obsession with this polarity.

21 The conceptual proximity to colonial readings of purported ›hunting magic‹ in non-Western societies is not accidental.

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# Clothing, messages, and identity – theoretical and methodological approaches to clothing in Central European prehistory

Karina Grömer

**Zusammenfassung**

Kleidung, Botschaften und Identität – theoretische und methodische Ansätze zur Kleidung in der mitteleuropäischen Vorgeschichte

*Kleidung ist für die menschliche Existenz ebenso unabdingbar wie die Nutzung von Werkzeugen und Feuer. Im vorliegenden Artikel liegt der Schwerpunkt auf Funden und Befunden der Steinzeit und der frühen Bronzezeit in Mitteleuropa. Visuelle Identitäten und Codes werden typischerweise mit vielen Facetten des ›Looks‹ einer Person in Verbindung gebracht, einschließlich Schuhwerk, Frisuren und verschiedenen Accessoires. In Europa stammen unsere Kenntnisse über prähistorische Stoffe und Kleidung aus vielen Quellen, wie z. B. verschiedenen Arten von Abbildungen (Figurinen und gemalte oder eingeritzte Darstellungen auf verschiedenen Materialien wie Keramik und Stein), aber auch aus schriftlichen Dokumenten der späteren Vorgeschichte. Von besonderer Bedeutung sind archäologische Textilien, obwohl organische Überreste nur unter bestimmten Bedingungen überleben. Wir nutzen auch Schmuck und Kleidungsstücke aus Gräbern (vor allem solche, die* in situ *in Gräbern gefunden wurden), um die visuellen Codes zwischen Kleidungsstücken und -ensembles zu beleuchten, die von bestimmten prähistorischen Gemeinschaften verwendet wurden.*

*Theoretische Konzepte der Kleidung werden ebenfalls angesprochen, um das Thema aus verschiedenen Perspektiven zu analysieren, darunter Kulturanthropologie, sog. material culture studies, Sozialpsychologie, evolutionäre Anthropologie und zeitgenössische Modestudien. Im Mittelpunkt der Diskussion stehen Theorien zu visueller Kodierung, nonverbaler Kommunikation, Modetheorie, Geschlecht, Alter und sozialer Hierarchie. Es ist von Bedeutung, ob archäologische Daten aus der Stein-, Bronze- und Eisenzeit die Beurteilung spezifischer Kleidungsarten im Zusammenhang mit der sozialen Stellung des Einzelnen, bestimmten Rollen innerhalb einer Gesellschaft, dem Alter oder dem Geschlecht erlauben.*

**Schlagwörter** Kleidung, Vorgeschichte, theoretische Konzepte, Sinne, nonverbale Kommunikation

**Summary**

*Clothing is as integral to human existence as the utilisation of tools and fire. Here, the focus is on finds and features of the Stone Ages and the Early Bronze Age in Central Europe. Visual identities and codes are typically associated with multiple facets of an individual's ›look‹, including footwear, hairstyles and various accessories. In Europe, our understanding of prehistoric garments and clothing comes from many sources, such as different kinds of images (figurines and painted or incised representations on various materials like pottery and stone), and also written documents in later prehistory. Of specific importance are archaeological textiles, although organic remnants only survive under particular conditions. We also use jewellery and dress fittings found in burials (especially those from* in situ *positions in graves) to elucidate the visual codes among garments and dress ensembles employed by particular prehistoric communities.*

*Theoretical concepts of clothing are also addressed to analyse the subject from diverse perspectives, including cultural anthropology, material culture studies, social psychology, evolutionary anthropology, and contemporary fashion studies. The discussion centres on theories pertaining to visual coding, nonverbal communication, fashion theory, gender, age, and social hierarchy. It is of interest whether archaeological data from the Stone Age, Bronze and Iron Ages allow for the assessment of specific kinds of clothing connected to the individual's social position, specific roles within a society, age or gender.*

**Keywords** Clothing, prehistory, theoretical concepts, senses, non-verbal communication

## 1. Introduction and theoretical framing

Since the Palaeolithic, clothing has been a fundamental necessity for human beings and can be found in great variations in all human cultures. This article aims to employ a framework involving theoretical aspects to discuss the significance of clothing as a medium of communication, various types of perception, and sensory aspects while encompassing numerous case studies from the Stone Age, Bronze Age, and some from the Iron Age in Central Europe (Fig. 1).

Clothing is understood here as the combination of garments and related accessories, such as dress fittings made of stone, bone and metal, as well as belts, brooches, pins, and various types of jewellery (e.g. necklaces, bracelets, and

**Fig. 1** Word cloud with various aspects of the study of clothing, created with wortwolken.com 2024.

***Abb. 1*** *Wortwolke mit verschiedenen Aspekten des Studiums der Kleidung, erstellt mit wortwolken.com 2024.*

anklets). In the understanding of modern costume theory (Cordwell/Schwartz 1979; Eicher/Evenson 2015, 2–27), in addition to clothing and jewellery, the outer appearance (the ›look‹) also includes shoes, headgear, hairstyles and even makeup and tattoos. Additionally, posture, facial expressions, and gestures are all considered to be components of external appearance in the broadest sense. Together, all of those factors constitute how a person presents him or herself to others; it literally ›communicates‹ with the viewers.

Humans, as members of social entities, may express their identities by their appearance, which serves as an important means of nonverbal communication (Grömer 2016; Roach-Higgins et al. 1995; Sommer 2012). Jewellery, worn on various parts of the body (especially around the neck and on arms and legs), is significant in prehistory in Central Europe; it finds different expressions throughout time and within certain geographical regions. Those objects attached to clothing are functional (serving to close or gather the garments) as well as decorative and even hold diverse symbolisms and meanings.

The origins of human body covering, which occurred thousands of years ago, is the focus of various research approaches. In various papers, I. Gilligan (e.g. 2010; 2016; 2019) argues that one of the principal purposes of clothing is thermal protection. This theory explains the development of clothing as one of the results of the loss of body hair and response to environmental change (Gilligan 2016, 2). As such, clothing is an important shield against thermal extremes, precipitation, and adverse weather conditions. According to Gilligan, this physiological necessity led to complex social demands and manifestations, subsequently resulting in feelings of sexual shame and modesty along with the emergence of the first expressions of fashion.

To set the interpretation of the evidence for prehistoric clothing in a more general perspective, some overarching ideas from historical and modern fashion studies might provide inspiration. The role of clothing in non-verbal communication is a focus of A. Lurie, who studied the use of dress ensembles in Northern America and Europe in the mid-20th century. In her work, »The Language of Clothes« (Lurie 1981), she asserts that specific garments and attire combinations, along with colour and choice of material, form a vocabulary (e.g. common words, eccentric ones, archaic or foreign words) and grammar as exact and laden with subliminal meaning as any verbal language. After Lurie, every individual possesses a fundamental repertoire of such words, phrases (how they combine individual items), and unique expressions related to their cultural, hierarchical, geographical, and socioeconomic background. This type of language is also used in movies, advertisements and media to convey immediate impressions regarding sex, age, socioeconomic standing, geographical origin, personality, opinions, tastes, and even current mood. Therefore, it might be of interest whether we can detect such mechanisms in prehistoric societies.

Another theory that may hold significance is discussed by G. Lehnert, a professor of contemporary fashion theory at the University of Potsdam. In »Der modische Körper als Raumskulptur« (Lehnert 2014), using historical and recent case studies, she suggests that clothing establishes a form of personal space. Garments are three-dimensional entities when worn; conversely – when not worn – they are two-dimensional and flat. The interplay between the clothing and the wearer is significant. This three-dimensionality of garments is also related to the fact that garments fulfil both practical and aesthetic needs.

Additionally, the American archaeologist P. Wells, in his work »Image and Response« (Wells 2008), specifically addresses the visual perception of clothing ensembles. Wells examines the visual attributes of Central European prehistoric grave goods (mostly the non-organic components such as jewellery and dress fittings) through the lens of research conducted by neuroscientists, social scientists, anthropologists, and art historians. Surfaces, edges, texture, colour, adornment, and sparkle are crucial in perception. The visual aspects of dress accessories and jewellery are typically focal points in studies of archaeological materials from prehis-

**Fig. 2a–c** The Venus of Willendorf, Austria, with details of the headdress and body adornment, 29 500 years old.

***Abb. 2a–c*** *Venus von Willendorf, Österreich, mit Details des Kopf- und Körperschmucks, 29 500 Jahre alt.*

tory, as the bone, shell, stone and metal elements survive the decomposition process.

There is more to consider aside from visual aspects: S. Harris (2019), in her remarkable paper »The sensory archaeology of textile«, examines textiles and clothing not solely from a visual perspective but also endeavours to incorporate other senses – olfactory, auditory, tactile, and kinaesthetic. She also provides a methodology for the study of those components. These elements are typically neglected in archaeological studies of clothing – only recently taken into account in specific research projects (Pomberger et al. 2023; Grömer et al. 2024; Gouy 2024).

The sources for our studies of prehistoric attire are varied. Pictorial sources, such as figurative art or paintings and incisions on ceramics are significant. The jewellery and dress accessories discovered in graves are of importance, together with analyses of their context and placement patterns. Generally, adornment that is permanently attached to the body (such as tattoos or non-removable jewellery) is to be distinguished from portable jewellery (Sørensen 1997). Organic materials belonging to garments could comprise, e.g. woven textiles, leather, fur, felt, or bast fibre, but they are quite rare in comparison with other artefact groups and can be found only under specific conditions (Grömer 2016). Among the earliest bast fibre textiles are the finds from Çatalhöyük, Turkey, dated to the 8$^{th}$ millennium BC (Loudon et al. 2023). From excavations in Central Europe, for example, woven textiles and grass mats are known from imprints on Early Neolithic pottery (Grömer 2016). Preserved plant materials like hats or shoes made of tree bast are known from Late Neolithic lakeside settlements in southern Germany and Switzerland (Banck-Burgess 2016). Mineralised textiles and leather were identified, attached to metal objects in Bronze and Iron Age graves. A large variety of artefacts made of organic materials like bast, fur, leather, or textiles have been found in prehistoric salt mines in Austria or in alpine glaciers (Kern et al. 2008). Research on textiles and their properties (raw material, technological details, quality, patterns, structures, etc.) is crucial to our understanding of clothing.

## 2. Into the deep history of clothing

The first known instances of human clothing and body coverings date back to the Palaeolithic when people lived as hunter-gatherers. Recent DNA analysis of human body lice may hold the key to understanding the origins of clothing. About 100 000–200 000 years ago, head and body lice separated, suggesting that by this point, people had already begun to cover their bodies (Bower 2010).

Evidence for the utilisation of materials such as shells, teeth, and ivory, either worn on the body or affixed to garments as adornments, originates from the Palaeolithic period. Bracelets, for example, are discernible on the wrists

**Fig. 3** Grub Kranawetberg, Austria. Ivory beads and mollusc shell ornaments, c. 30 000 years old; no scale.

***Abb. 3*** *Grub Kranawetberg, Österreich. Perlen aus Elfenbein und Muschelschalenschmuck, ca. 30 000 Jahre alt; o. M.*

of the otherwise unclothed 29 500-year-old Venus of Willendorf, Austria (Fig. 2) (Antl-Weiser 2008). Her elaborated hairstyle, which might also be a cap decorated with shells as known from other Palaeolithic sites, is also remarkable. In the collections of the Natural History Museum Vienna, among the artefacts from Willendorf – a site with multiple archaeological layers – are also numerous shell items and ivory beads (Fig. 3) (Antl-Weiser 2018, 95).

Comprehensive overviews of pictorial sources and adornments found on Palaeolithic and Mesolithic sites are provided in this volume by various authors. Of specific interest in this respect are the grave finds. Numerous ivory beads were unearthed in the graves at Sungir in Russia, dated to approximately 24 000 years ago. Their arrangement pattern implies the deteriorated fabric to which the beads were likely fixed. This is a prominent example of evidence for sewn garments (Bader/Bader 2000). For the Mesolithic, the items in the shaman´s grave at Bad Dürrenberg in Central Germany (Meller/Michel 2022; Orschiedt et al. 2023) represent the most remarkable ensemble of body ornaments; these finds inform the distinctive reconstruction presented at the State Museum of Prehistory at Halle (Saale).

The earliest evidence for sewing needles comes from Central Asia and is 45 000–35 000 years old, whilst the use of sewing needles in Europe dates back to c. 30 000 BC (see Borao Álvarez et al. and Kandel et al. in this volume). From Austria, examples of sewing needles include finds from the Austrian Gudenushöhle (Obermaier/Breuil 1908, Pl. III) displayed at the Natural History Museum Vienna (Fig. 4). The technology of using eyed needles, which enables the user to sew directly with thread points to advanced clothing types. In the time of the hunter-gatherers, mainly fur or leather were used as organic components of garments, as well as sometimes plant materials for cordage, twined and plaited items.

There was a material turn in the Neolithic agricultural societies, as they introduced a significant advancement: the capability to weave larger textiles, which then became the basis for clothing. Over 9000 years ago, the fundamental techniques of spinning, weaving, and subsequently patterning were established (Barber 1991). In Central Europe, from the Linear Pottery culture (5600–4900 BC) onwards, evidence deduced from figurines indicates the production of basic linen textiles to produce various kinds of garments (e.g. Lüning 2006; Becker 2011), whilst fabrics made of sheep wool seem to be an achievement of the 3rd millennium BC (Grömer 2016). Graves from that era (e.g. Nieszery 1995) contain jewellery crafted from shell and bone as well as belt components. Initial hints for elaborate hairstyles may be inferred from figurines (e.g. Eilsleben in Central Germany; Lüning 2006) and from graves where combs fashioned from bone and antler were utilised in hair arrangements.

From the Middle Neolithic in Central Europe (especially Lengyel Culture), we know of an abundance of anthropomorphic figurines. They are usually naked, with one impor-

**Fig. 4** Sewing needles from the Gudenushöhle, Austria, from the Palaeolithic period; no scale.

***Abb. 4*** *Nähnadeln aus der Gudenushöhle, Österreich, aus dem Paläolithikum; o. M.*

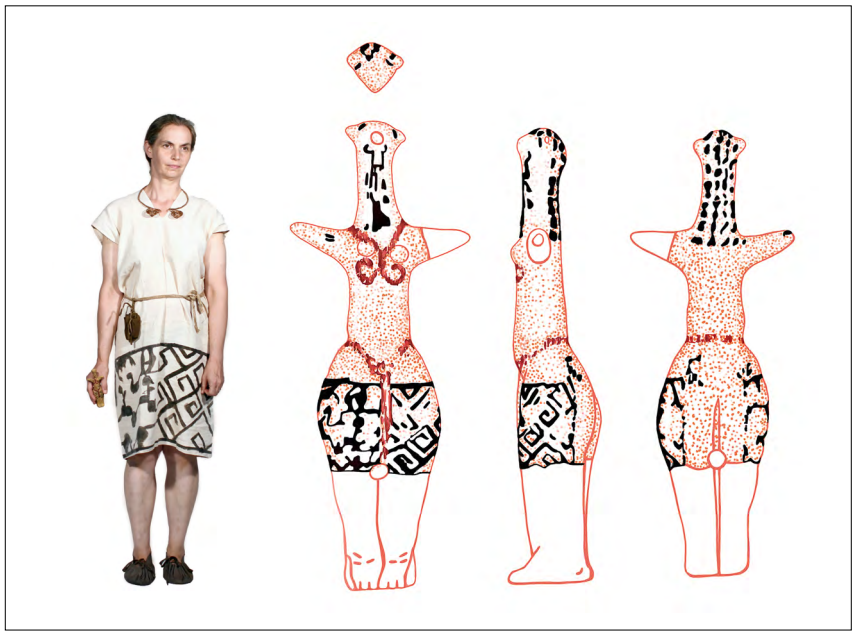

**Fig. 5** Figurine from Falkenstein, Austria, from the Middle Neolithic period and recreation of a painted mini-dress as shown on the statuette.

***Abb. 5*** *Figurine aus Falkenstein, Österreich, aus dem Mittelneolithikum und Nachbildung eines bemalten Minikleides wie auf der Statuette.*

tant exception: a little statuette discovered in Falkenstein, Austria (Lenneis et al. 1995, 100), within a 6900-year-old fortification system. The black-patterned design might indicate a painted mini-dress made of linen cloth (Fig. 5) or leather; alternatively, it may just refer to a form of body painting. The late Middle Neolithic vessel (Münchshöfen Culture) found in Murr, Germany (Neumaier 1996, Fig. 26; Pl. 16), provides insight into the silhouettes of Neolithic garments, as it shows long belted dresses.

In the Late Neolithic period, particularly in southern France, northern Italy, and Switzerland, larger stone figures were found that displayed clothing. Late Neolithic attire in Central Europe seemingly incorporated headgear made of grass and tree bast, such as that discovered in lakeside dwellings in southern Germany and Switzerland (e.g. Feldtkellner/Schlichtherle 1987, Fig. 2–8; see Hafner in this volume).

The most famous Stone Age garment assemblage from Central Europe is associated with the so-called Iceman, ›Ötzi‹, dated to 5300 years ago (Egg/Spindler 2009; see also Hafner in this volume). The mummy was found in 1991 in the Alps on the border between Austria and Italy. This is the only find of a Stone Age individual's complete garment ensemble from Europe (Fig. 6). He wore tight leggings tied to his belt with leather strips, while the belt also secured a loincloth. On his upper body, ›Ötzi‹ wore a patchwork garment made of differently coloured fur strips sewn together. His ensemble also included a bearskin cap, a grass cape and shoes.

Although metal (gold and copper) was already used for jewellery and dress fittings in the Neolithic, the widespread use from the Bronze Age onwards had a massive impact on garments, their layout and embellishment. The form and decoration of dress fittings (like pins, belts, and later, fibulae) and jewellery (bracelets, anklets, necklaces, etc.) are distinctive markers of cultural groups in the Bronze and Iron Ages, as well as a strong chronological hint. Their placement – for example, if fibulae are worn paired on the shoulders, singly in the chest area, or even three at a time in different positions – differs according to region and date. This also provides hints for certain garment types (compare Grömer 2016, Fig. 237).

Some grave finds from Central Europe might serve as examples for later periods: The Early Bronze Age female burials from Franzhausen, Austria, display a variety of bronze objects (Neugebauer/Neugebauer 1997; Grömer/Neugebauer-Maresch 2017). As a Middle Bronze Age example from the Danube region, there is a remarkable high-sta-

**Fig. 6** Recreation of the Man in the Ice (›Ötzi‹) as displayed in 2007 at the Natural History Museum Vienna.

***Abb. 6*** *Nachbildung des Mannes aus dem Eis (»Ötzi«), wie 2007 im Naturhistorischen Museum Wien ausgestellt.*

tus garment from Winklarn in Austria (Grömer et al. 2013; see below Fig. 10); the ensemble includes spiked pendants, a wide bronze belt, and elongated, pointed pins. Burials of high-ranking females with two fibulae and belt components from the cemetery at Hallstatt, Austria (Kromer 1959; Kern 2018), also provide clues for our studies.

We also have pictorial sources from the mid-Iron Age in Central Europe: the situla art (Turk 2005) discussed briefly, below. For our understanding of the silhouettes and shape of garments, we also gain information from complete garments that are known, for example, from the oak coffin burials in Denmark, dating to c. 1500 BC (Mannering et al. 2012) and from various bog finds in Northern Europe, dating to the Iron Age, e.g. Huldremose in Denmark or Thorsberg in Germany (Mannering et al. 2012; Möller-Wiering/Subbert 2012).

## 3. Clothing, Messages, and Identity

Clothing in all its facets serves as a form of non-verbal communication – apparel and ›look‹ allow a discourse between the individual and society (Fig. 7). However, due to the paucity of written sources in prehistory, it is not easy to make complex, concrete statements about the significance that appearance and thus adornment had for people.

As discussed earlier, the total visual appearance of the ensemble surpasses that of the individual components: the combination of different items from head to toe must be considered. The choice of headgear, shoes, and the garment's silhouette (which body parts are exposed or concealed, such as the feet or abdomen) are crucial, as well as which and how many items of jewellery, dress fittings and other accessories are used.

To evaluate the overall composition, the specific colour combinations of the furs, textiles, jewellery, and dress accessories should also be taken into account. The visual characteristics of fabrics and garments are influenced by the texture and quality of the material (is the textile dense or more transparent); the patterns and colours, along with shimmer and reflections, are of significant value, as noted by P. Wells. This is particularly relevant for dress accessories made of metal.

### 3.1 Expressing identities

The above-mentioned facets of visuality pertain to direct, non-verbal communication and interpersonal contact. Cultural identities such as gender, social roles or status can be expressed through those visual signs (e.g. Sørensen 1997; Martin/Weetch 2017; Mattson 2021), which are discussed in the following with some examples.

The exceptional ensemble of items accompanying the body in the Mesolithic burial from Bad Dürrenberg, Saalekreis District, Germany (Orschiedt et al. 2023), can be interpreted as parts of the complex costume of a shaman. The 30–40 year old woman had – along with other items – headgear made of deer antler and many pierced teeth in the area of her head: six boar tooth lamellae, of which two were pierced, six pierced incisors from wild boar that show signs of wear, 33 incisors and three canines of bison/aurochs, half of which were pierced, as well as 16 incisors and two unperforated canines from red deer (Orschiedt et al. 2023, 126). The focus of this costume clearly enhances the head and upper body. With this ensemble, a strong visual hint at a specific role within that society is addressed.

Evidence for specific roles can also be examined in later times, such as the Early Bronze Age clothes from graves 110 and 747 in Franzhausen, Traisen Valley, Austria (2200–2000 BC) (Grömer/Neugebauer-Maresch 2017). The key pieces are the bronze elements found in the chest area, which were sewn onto the garments, as well as pins, bracelets, and the headgear. The placement pattern, i.e. where the bronze dress fittings are located on the body, tells us a great deal about the kind of garment they might have adorned. Additionally, in grave 110, a massive headdress was placed around the head. In this, a piece of fabric was identified. The

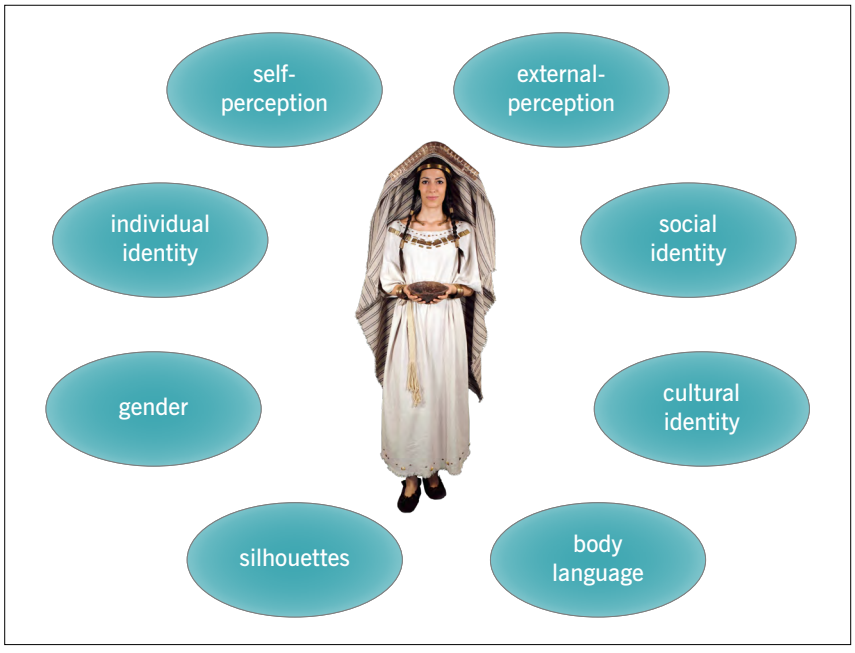


**Fig. 7** Aspects of non-verbal communication with garment ensembles.

***Abb. 7*** *Aspekte der nonverbalen Kommunikation mit Kleidung.*

**Fig. 8** Recreations of costumes as found in the Early Bronze Age burials 110 and 747 in Franzhausen, Austria, in daylight and exposed to artificial light (fire).

***Abb. 8*** *Nachbildungen von Gewändern, wie sie in den frühbronzezeitlichen Gräbern 110 und 747 in Franzhausen, Österreich, gefunden wurden, bei Tageslicht und unter künstlichem Licht (Feuer).*

colour of the linen had become greenish, but we can see that it had a striped pattern. This is the oldest striped textile we know from Central Europe (Grömer 2016, Fig. 98).

The recreation of the dress ensembles (Fig. 8) was based on the different garments involved. Grave 110 includes an elaborate headpiece and linen was found in the burial. As

such, a linen dress and striped veil were recreated. For burial 747, which had similar metal elements (except for the headpiece), garments were recreated based on finds from oak-coffin graves in Denmark – a blouse and skirt. These two costumes allow us to examine potential perceptions. They accentuate different body parts, and – when moving – the impact on the space surrounding the person differs significantly. The headdress of the woman from grave 110 definitely emphasises her head, as the bronze bow on her head and the embroidered elements at her neckline create a frame around her face. The emphasis of the recreation of grave 747 is primarily the upper body, where the shimmering bronze adornments are located. Clearly, the signalling value of the impressive headgear placed the woman wearing it in a specific role within society. Additionally, this kind of headgear is found quite rarely in the Traisen Valley, but other components (bracelets, decorative elements on the chest, pins etc.) are found among the social upper 20% of the females at the Franzhausen cemetery (Neugebauer/Neugebauer 1997). Within those Bronze Age societies, different items and sets of garments and jewellery existed that were available to females within the society – expressing their status, economic wealth, or other aspects of social identity (age group, marital status ...). In this way, the items served as ›words‹ in an unspoken language, as A. Lurie (1981) put it.

Aside from status and specific roles within a society, gendered designs can also be detected. From the earliest farming societies onwards, when we have evidence from larger cemeteries, different items were placed into burials of females and males – including different jewellery and dress fittings. This points to the fact that biological sex was also expressed via visual signals in those societies. The large Linear Pottery cemeteries in Bavaria, such as Aiterhofen-Ödmühle (Nieszery 1995, e.g. Pl. 13; 26; 50; 52) are good examples. For example, females are distinguished by Spondylus shells in the belly area (as a decorative or functional element of a belted garment, which creates a silhouette enhancing the waist). Additionally, shell necklaces and combs suggest a specific hairstyle.

Those principles were also followed in the Bronze and Iron Ages in Central Europe, since in the graves different dress components and jewellery can regularly be found along with anthropologically determined females or males. For the Iron Age, situla art (Turk 2005; Grömer 2016, 221), with its more or less detailed pictorial evidence, also documents distinct clothes for men and women. Women are typically depicted with veils and elongated garments; occasionally, chequered fabric is illustrated. Male images in situla art display other kinds of garments – various hats and caps, knee-length tunics, cloaks, and also trousers. They appear for the first time in Central Europe around 600–500 BC – presumably arriving from the East, as the oldest trousers worldwide are known from the Taklamakan Desert in China c. 1000 BC, connected with horseback riding (Beck et al. 2014). The belt-plate from Molnik, Slovenia (Turk 2005), and the scabbard from Hallstatt, Austria

**Fig. 9** Various materials used for Stone Age garments.

***Abb. 9*** *Verschiedene Materialien, die für steinzeitliche Kleidungsstücke verwendet wurden.*

**Fig. 10a–b** Ensemble from Winklarn, Austria, at the Natural History Museum Vienna and recreation of the outfit.

***Abb. 10a–b*** *Ensemble von Winklarn, Österreich, im Naturhistorischen Museum Wien und Nachbildung des Gewandes.*

(Grömer 2016, 222), show trousers, while actual trousers are known from bog finds in Northern Europe (Möller-Wiering/Subbert 2012).

### 3.2 Self- and external perception: visuals, touch, sound, and light

For external perception, the visual components of costumes discussed above are important, but there is also a need to add an additional dimension: how does a garment or costume look in daylight, at night or in artificial light? This also includes considerations of what kinds of lighting were possible in past times when sunlight was unavailable: moonlight and firelight from different sources. How is the perception of a garment affected by darkness or the light of a fire?

There are materials used for clothing ensembles that reflect artificial light (such as bright, polished ivory beads), while others (like dark furs or leather) are not that visible. This effect is even more impressive in periods when metal is used. Again, the two garment-ensemble reconstructions from Franzhausen might serve as examples of these principles (Fig. 8). The shimmering headgear of burial 110, along with the quantity of bronze decorative objects around the neckline, would create a glittering frame around the face when lit by a fire. Whether by chance or not – the headgear also looks as if the wearer would carry the moon on her head. The use of white linen also enhances this effect. The darker colours of the wool skirts and cloak chosen for the recreation of burial 747 lend a different effect, rendering parts of the costume and the person invisible.

In addition to the previously mentioned visual signals, in this respect, the tactile and auditory aspects as defined by S. Harris (2019) are also important. Tactile or haptic experiences are essential for the self-perception of a person wearing a garment ensemble. Garment components involving fabrics and elements made of stone, shell, metal or glass include varying attributes such as weight, thermal conductivity (e.g. wool or fur differs from metal in temperature sensation), thickness, flexibility, and mechanical characteristics. Additionally, the comfort factor must be considered, namely the tactile sensation of the materials against bare skin: bast items versus leather or fur, coarse textiles versus smooth ones, and ivory versus metal (including the sharp points of pins; Fig. 9).

Also, other properties of materials should be noted: leather, fur, and textiles are elastic and move together with the body, while mollusc shells and other materials used for decoration are rigid substances. This interplay between different materials and their specific properties can be experienced, for example, on garments such as those found in the Sungir graves, Russia (Bader/Lavrushin 1998), where some mollusc shells and thousands of ivory beads were attached to their surfaces.

This can also be discussed in terms of external perception. Different haptics transmit messages to those who perceive or even touch a person wearing a specific garment ensemble. One of the most impressive examples is known from the Middle Bronze Age: the ensemble from Winklarn, Austria (Fig. 10), with large pins, bracelets, a massive bronze belt and a necklace consisting of spiked pendants (Grömer et al. 2013). It is essential to note that this type of jewellery

served as a prestige symbol for the upper strata of the social hierarchy 3500 years ago. It served as a psychological and physical barrier to physical contact.

Another important factor, both for self- as well as external perception is sound. It is essential to examine the relationship between sound-producing items and others that are relatively silent in the context of attire. This pertains to the way an individual moves in their attire. Sound perception (Harris 2019; Pomberger et al. 2020; Grömer et al. 2024) is influenced by various aspects, including the sound's location, loudness, and tonality. Rattling elements of stone, bone and ivory, and in later periods, metal (bells, pellet bells, and items with jingling pendants), are frequently affixed to clothing. In recent years, this also has been examined through an interdisciplinary method involving music-archaeological, acoustic, and psychoacoustic study at the Natural History Museum, Vienna (Pomberger et al. 2023), with investigations of sound-producing Iron Age Hallstatt-period attire such as the large brooches with tintinnabula from the eponymous site of Hallstatt, Austria. For this period, we can discern a specific sound field that was created by women of the higher social strata. In this case, the particular sounds of the ratting jewellery – found only in very rich graves – might also have served as an indicator of wealth and attractiveness.

One of the most interesting Stone Age assemblages, where sound is an integral part of the overall clothing ensemble, furnished the burial of the female shaman of Bad Dürrenberg. The various elements would have rattled and clattered against each other during movement – signalling specific activities and, as such, acting as a decisive factor in external perception and nonverbal communication.

### 3.3 Body language and options for movement

As pointed out by various scholars, in addition to all the physical components of garment ensembles, gesture, posture, and overall body language are also components of external appearance (Cordwell/Schwartz 1979; Eicher/Evenson 2015). In particular, body language and movement options are impacted by garments, including how they are made and what materials are used. There are differences in movement if fitted garments are worn – such as those known from the Iceman, ›Ötzi‹ – or draped garments, such as the distinctive variants of the Roman toga.

The options for movement may sometimes hint at how representative a costume is – and thus also be a marker for social status. In the case of the often-mentioned early Bronze Age grave 110 from Franzhausen, the headgear significantly affects both the overall silhouette and the wearer's posture and gestures. She must maintain an erect posture; otherwise, the headgear might slip off her head. Her inability to bow might signify that she would not be obliged to serve anyone. This woman lived in a culture that was beginning to establish a hierarchical system, since the bronze artefacts in the cemeteries mark socioeconomic inequalities. A spatial impact of the garment ensemble is particularly evident when the woman moves and rotates. When viewed from the rear, no human silhouette is discernible. This individual occupies considerable space and possesses a pronounced three-dimensionality, as articulated by G. Lehnert (2014) in her theories.

## 4. Outlook

Clothing provides protection against environmental elements, including rain, cold, and heat. There are many hints that the clothed body served as a medium of communication in prehistoric societies as early as the Stone Age. Clothing – the overall dress ensemble as well as the single items – was used like a language to express identities and had a significant impact on both external perception and self-perception. As demonstrated by the evidence of specific jewellery and dress fittings from burials, social identities such as gender and age might be indicated by clothing as far back as the Stone Age and particularly in the Metal Ages. Especially from the Bronze Age onward, clothes and jewellery also served as indicators of social position, economic wealth and affiliation with various regional groups and thus may define cultural identities. Clothing also affects the body: it alters the surface, texture, and silhouette. Articles of clothing as three-dimensional entities and items worn on the body also significantly impact body language and movement choices. It might be an interesting topic for future studies to identify the principles of functional design – as can be seen, for example, in the thermal insulation properties of ›Ötzi's‹ shoes (they are made in layers with stuffed inlays).

A major component of clothing is its visuality. In this article, we also added the dimension of visual perception in daylight, at night or with artificial light – which also might have an impact on how clothing is used. For future research, it might be interesting to study perception from a distance versus perception in close proximity: what was seen, and by whom? Who might have been allowed to come close enough to a person to spot the finer details?

The tactile experience should also be addressed. This involves the particular properties of the materials used for clothing (e.g. elasticity, temperature, and softness) and the haptic differences in the interaction between various materials such as wool, linen, ivory, shells, or metal. The auditory experience must also be acknowledged. Some of the items attached to garments or worn as jewellery also produce sound and thus create a sound field around the wearer who moves within it. Those are important factors for the person wearing the garment ensemble – affecting self-perception as well as external perception. Through the lens of sensory qualities and thoughts on the three-dimensionality of garments, we obtain fresh insight into the cultural and even societal impact of clothing and jewellery in prehistoric societies by decoding the language of clothing.

## 5. Acknowledgements

My warmest thank goes to Harald Meller and the team in Halle for the invitation to hold the keynote lecture of the conference. Parts of the studies have been carried out within the framework of the COST Action EuroWeb –

Europe Through Textiles: Network for an integrated and interdisciplinary Humanities (2020–2024, COST Grant Nr. CA19131). I am thankful to various museums, institutions and Cultural Heritage Authorities Austria (Bundesdenkmalamt, BDA) for providing valuable information on organic finds from archaeological sites in Austria.

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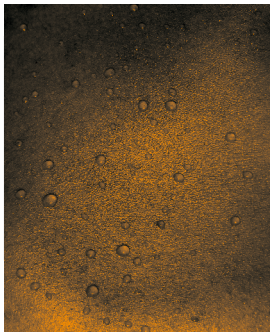
# SEKTION III: KLEIDUNG ALS MITTEL ZUM SCHUTZ UND WOHLBEFINDEN

# SECTION III: CLOTHING AS A MEANS OF PROTECTION AND WELL-BEING



Die nahezu haarlose Haut des Menschen ist zugleich Schutz- als auch Sinnesorgan, mit unter Primaten einzigartigen Eigenschaften (Foto: Ilia auf Unsplash).

*The almost hairless skin of humans is both a protective and sensory organ, with properties unique among primates (Photo: Ilia on Unsplash).*

# Evolution of the human skin barrier as innovative clothing

Cristina de Guzman Strong

**Zusammenfassung**

Evolution der menschlichen Hautbarriere als innovative Kleidung

*Die Haut ist das äußerste Organ, das den menschlichen Körper ›kleidet‹. An der Oberfläche der Haut befindet sich die Epidermis, ein Gewebe, das aus Keratinozyten besteht, die eine Schutzbarriere gegen die Umwelt bilden. Um diese schützende Epidermis zu bilden, durchlaufen die Keratinozyten eine terminale Differenzierung, die durch die Expression von Strukturproteinen gekennzeichnet ist, die von Genen im Epidermalen Differenzierungskomplex (EDC) Lokus kodiert werden. Dieser Satz von Genen ist bekanntlich der sich am schnellsten entwickelnde Lokus im menschlichen Genom. Dies geht aus vergleichenden Studien mit dem Schimpansengenom hervor und verdeutlicht die Bedeutung von Evolution und genetischer Variation für die Barrierefunktion der menschlichen Haut. Hier diskutieren wir unsere bahnbrechenden Erkenntnisse über die Identifizierung spezifischer EDC-Gene, die sowohl in der Phylogenie der Säugetiere als auch beim modernen Menschen einer positiven Selektion unterworfen waren. Außerdem heben wir unsere Entdeckung der jüngsten Evolution der menschlichen Hautbarriere außerhalb Afrikas hervor. Ein spezifischer Haplotyp, der mit einer Zunahme des epidermalen Proteins Involukrin und der nachgelagerten Funktion des Vitamin-D-Rezeptors in der Epidermis assoziiert ist, unterlag in nordeuropäischen Populationen im Vergleich zu afrikanischen Populationen einer nahezu selektiven Auslese. Unsere Ergebnisse zeigen eine genomisch kodierte Strategie, um die modernen Menschen, die Nordeuropa bevölkerten, mit mehr Involukrin auf ihrer Haut zu ›bekleiden‹. Wir kontextualisieren unsere Ergebnisse mit anderen neueren adaptiven Merkmalen der menschlichen Haut, einschließlich Pigmentierung und Haarlosigkeit, und betrachten die Entstehung von exogener Kleidung in diesen evolutionären Zeitskalen für die Entwicklung des modernen Menschen.*

**Schlagwörter** Haut, Barriere, Evolution, Involukrin, Vitamin-D-Rezeptor

**Summary**

*The skin is the outermost organ that ›clothes‹ the human body. At the surface of the skin is the epidermis, a tissue comprised of keratinocytes that provide a protective barrier against the environment. To form this protective epidermis, keratinocytes undergo terminal differentiation marked by the expression of structural proteins encoded by genes in the Epidermal Differentiation Complex (EDC) locus. This set of genes is known to be the most rapidly evolving locus in the human genome based on comparative studies of the chimpanzee genome, thus identifying the significance of evolution and genetic variation for the human skin barrier function. Here, we discuss our seminal findings identifying specific EDC genes that have undergone positive selection both in mammalian phylogeny and in modern humans. We further highlight our discovery of the recent evolution of the human skin barrier out-of-Africa. A specific haplotype associated with an increase in the epidermal protein, involucrin, and downstream Vitamin D receptor function in the epidermis underwent a near selective sweep in Northern European populations compared to that of African populations. Our results reveal a genome-encoded strategy to ›clothe‹ the modern humans that populated Northern Europe with more involucrin on their skin. We further contextualize our findings with other recent human skin adaptive traits, including pigmentation and hairlessness, and consider the emergence of exogenous clothing with these evolutionary timescales for modern human evolution.*

**Keywords** Skin, barrier, evolution, involucrin, vitamin D receptor

The human body is protected or ›clothed‹ by our skin. This protection or barrier function is imparted by epidermal cells or keratinocytes that comprise our epidermis at the surface of the skin (Fuchs 2008) (Fig. 1). The epidermis is an exquisite cellular architecture of distinct layers of keratinocytes that stratify across the entire body. The innermost layer of the epidermis is comprised of basal keratinocytes that proliferate and self-renew. During asymmetrical division, a basal keratinocyte generates two daughter cells, one that self-renews and the other that moves upward towards

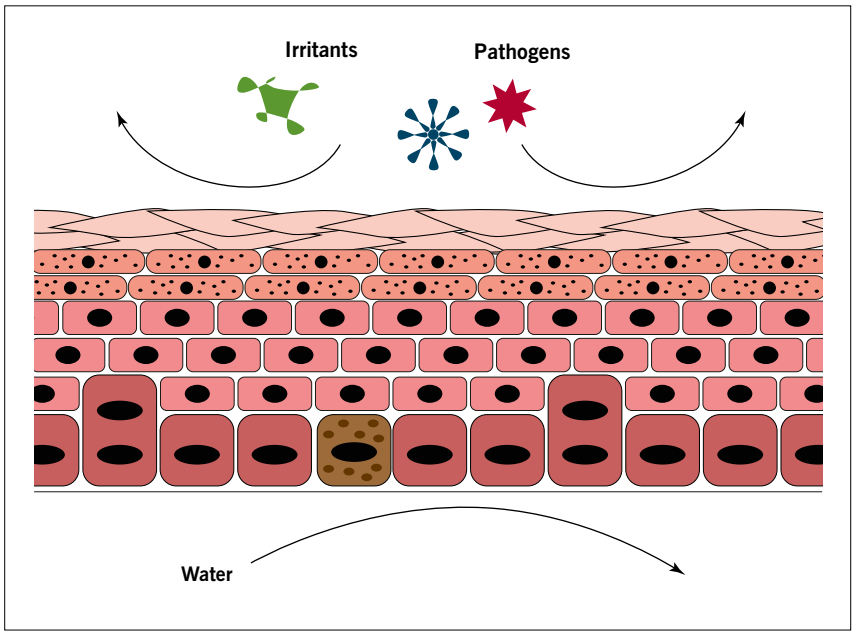



**Fig. 1** Schematic of the epidermis comprised of keratinocytes that form stratified layers as a physical barrier against harsh environmental factors (e. g. irritants and pathogens) and prevent water loss.

***Abb. 1*** *Schematische Darstellung der Epidermis, die aus Keratinozyten besteht, die stratifizierte Schichten als physische Barriere gegen raue Umweltfaktoren (z. B. Reizstoffe und Krankheitserreger) bilden und den Wasserverlust verhindern.*

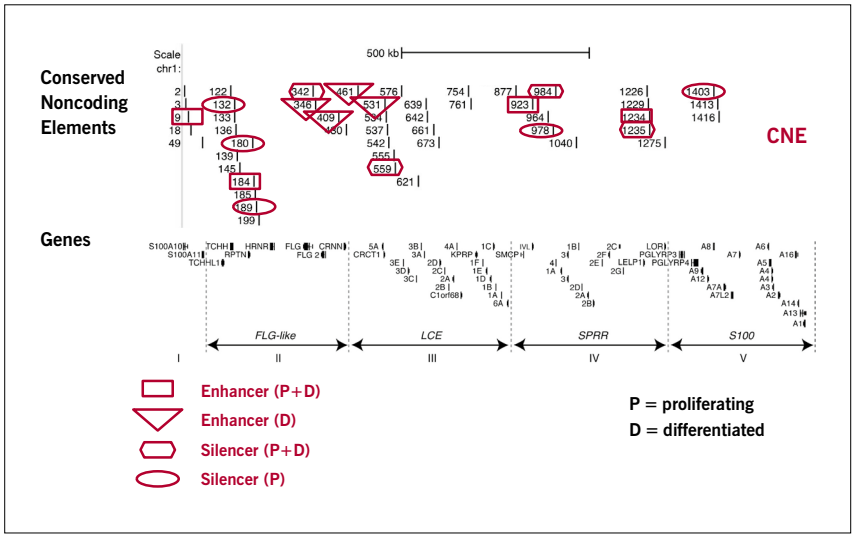



**Fig. 2** Genome track of genes Epidermal Differentiation Complex (EDC) locus (bottom track) located on human chromosome 1q21 and conserved noncoding elements (CNEs) (top track). CNEs are numbered to indicate the number of kilobase away from the most 5'EDC gene, S100A10. Red geometric shapes correspond to CNEs that exhibit either enhancer or silencer activity in proliferating (P) and/or differentiated (D) keratinocytes.

***Abb. 2*** *Genomspur des Epidermalen Differenzierungskomplex (EDC) Lokus (untere Spur) der Gene auf dem menschlichen Chromosom 1q21 und konservierte nicht-kodierende Elemente (CNEs) (obere Spur). Die CNEs sind nummeriert und geben die Anzahl der Kilobasen an, die vom 5' EDC-Gen, S100A10, entfernt sind. Die roten geometrischen Formen entsprechen den CNEs, die entweder Enhancer- oder Silencer-Aktivität in proliferierenden (P) und/oder differenzierten (D) Keratinozyten aufweisen.*

the surface of the skin and begins terminal differentiation (Lechler/Fuchs 2005). This reiterative process forms the differentiated layers of the epidermis to essentially ›clothe‹ the entire body and selectively prevents the penetration of irritants and pathogens and loss of water from the inside out.

As keratinocytes differentiate, they coordinately express genes encoded from the Epidermal Differentiation Complex (EDC) locus (Volz et al. 1993; Mischke et al. 1996; Zhao/Elder 1997). The EDC contains four gene families based on their protein sequence homology: FLG-like (filaggrin-like), LCE (Late Cornified Envelope), SPRR (Small Proline Rich Region), and S100 proteins (Fig. 2). Involucrin is one of the major EDC proteins whose expression is a hallmark marker for terminal differentiation in keratinocytes (Rice/1979). Involucrin is known to be a major scaffolding protein for other SPRR and LCE proteins that are cross-linked together to form the cornified envelope that surrounds and renders the keratinocyte the ›building block‹ of the skin barrier (Simon/Green 1985; Etoh et al. 1986). These individual blocks are, in turn, sealed together by lipids that are extruded from these keratinocytes to further reinforce protection (Landmann 1986; Wertz 1991; Marekov/Steinert 1998). The collection of EDC proteins in the epidermis contributes to physical barrier function as well as the maintenance of this tissue in coordination with proper immune response.

Motivated by the coordinate gene expression during terminal differentiation, we hypothesized the presence of regulatory elements in the EDC or non-coding DNA sequences to activate gene expression. In comparison to at least 60 human EDC coding genes, we discovered 48 sequences in the EDC that are highly conserved across seven mammals (including humans) yet do not code for protein, hence referred to as conserved non-coding sequences or elements (CNEs) (de Guzman Strong et al. 2010). Conservation of these sequences suggests an element of biological function to maintain these sequences over the course of evolution. We later determined that approximately half of the CNEs exhibit regulatory activity to activate (or enhance) or repress (or silence) reporter gene expression in proliferating

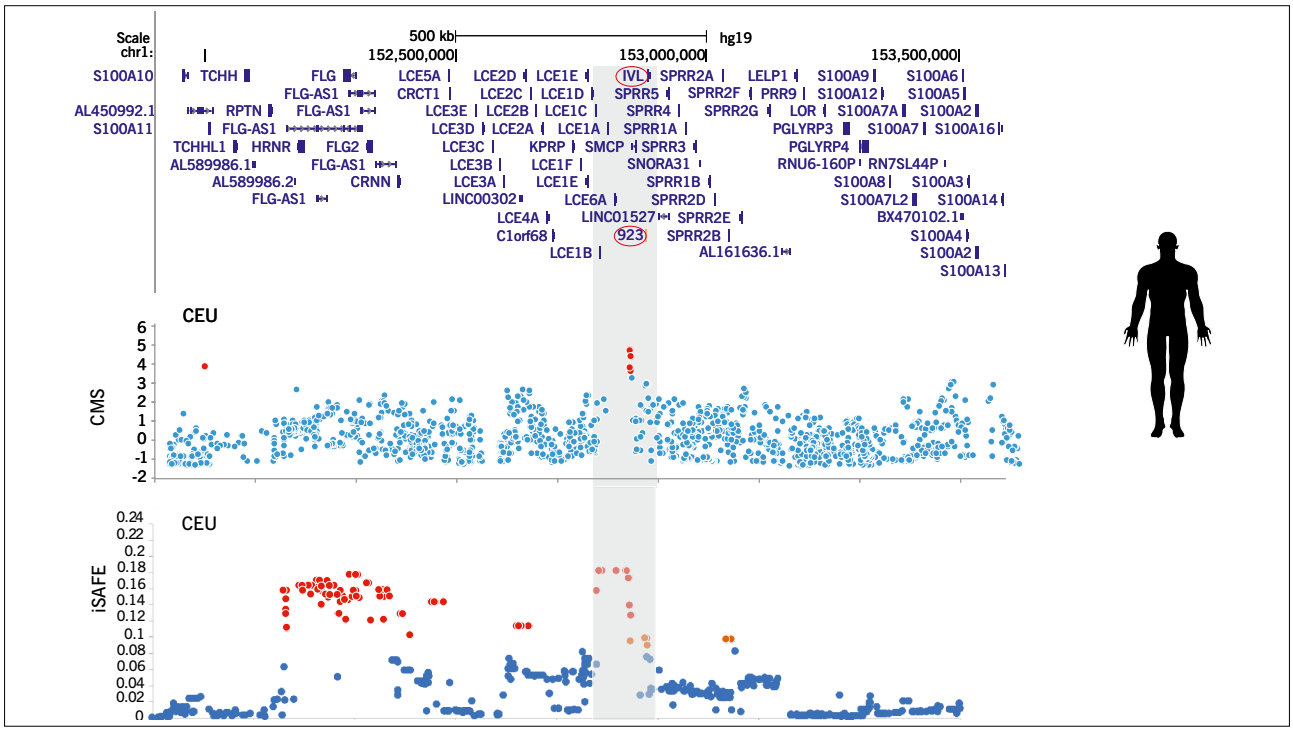



**Fig. 3** Positive Selection for involucrin gene *(IVL)* in human CEU (N. European) 1KGP population as determined by the shared region of significantly high CMS and iSAFE scores (grey region).

***Abb. 3*** *Positive Selektion für das Involukrin Gen* (IVL) *in der menschlichen CEU (N. European) 1KGP Population, bestimmt durch die gemeinsame Region mit signifikant hohen CMS- und iSAFE-Scores (graue Region).*

and differentiated keratinocytes (Fig. 2). Our finding thus identified enhancers and silencers, respectively, in the EDC for proper coordination of gene expression in keratinocytes. The elucidation of these key elements was crucial for us to further decode genetic variation and functional significance in the EDC in our later studies.

The complete sequencing of the chimpanzee *(Pan troglodytes)* genome was pivotal in finding significance for genetic changes within the EDC in humans. By aligning and comparing the chimpanzee genome to the human reference genome, it was determined that the EDC was the most rapidly evolving locus in the human genome (The Chimpanzee Sequencing and Analysis Consortium 2005). In other words, the human EDC exhibited the highest number of nonsynonymous amino acid substitutions in its protein-coding genes owing to significant changes in single nucleotides compared to that of the chimpanzee. The discovery revealed positive selective pressure on these genetic changes for the skin in human evolution that is poorly understood. This finding motivated us to further examine the significance of the evolution of the EDC over timescales of mammalian phylogeny and across modern human populations that are geographically distinct.

We first sought to determine the macroevolution of the EDC in mammalian phylogeny. Is there evidence of positive selection in the EDC in mammals? Using statistical methods to determine the significance of nonsynonymous amino acid substitutions across 14 mammals via likelihood ratio tests, we identified positive selection for *FLG*, *SPRR4*, *LELP1*, and *S100A2* genes across mammalian phylogeny (Goodwin/de Guzman Strong 2016). We also determined ongoing positive selection for *SPRR4* in primates, thus supporting more recent evolution in our closest ancestors that was ongoing.

These findings led us to ask questions about more recent microevolution of the EDC in modern humans. In other words, is our human skin barrier evolving? To address this question, we determined and examined signatures of positive selection for each EDC single nucleotide polymorphism (SNP, also known as a common single DNA base pair change) that was publicly available for each of the 1000 Genomes (1KGP) populations – CEU (Northern European), YRI (Yoruba, Africa), and CHB/JPT (pooled Han Chinese and Japanese) (Mathyer et al. 2021). We identified a genomic region in the CEU population that was shared by a set of SNPs that exhibited both significantly high CMS and iSAFE positive selection scores (Fig. 3). A closer examination of these SNPs revealed that they comprise a specific haplotype or a group of DNA variants that are inherited together for the involucrin gene. Using GTEx data, we determined the significance of this positively selected haplotype for more involucrin gene expression in non-sun-exposed human skin. By examining the allele frequency and distribution of this haplotype in other modern human populations in Africa, Southeast Asia, and Europe, we determined a near selective sweep for the selection of this haplotype in Northern Europe that correlated with an increase in northern latitude position. We sought to further demonstrate the significance of the 923 CNE as a putative enhancer for involucrin gene expression. The 923 CNE was deleted using CRISPR/

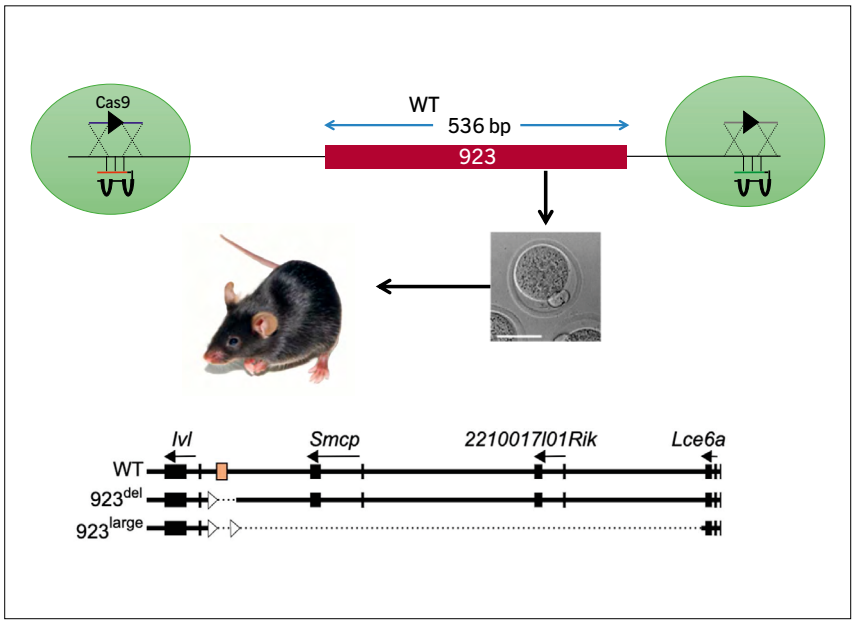



**Fig. 4** Strategy to delete 923 CNE in mouse genome by CRISPR/Cas9 genome editing of mouse embryonic stem cells and injection in pseudopregnant mice resulting in two independent mouse strains for the deletion of 923 CNE, $923^{del}$ and $923^{large}$. Arrowhead lines indicate the homologous sequence (marked by dotted X) and loxP site (arrowhead) for CRISPR-mediated recombination by Cas9 nuclease and guided by CRISPR gRNA as shown with the red and green hairpin structures below the targeted locus.

***Abb. 4*** *Strategie zur Löschung von 923 CNE im Mausgenom durch CRISPR/Cas9 Genome Editierung von embryonalen Stammzellen der Maus und Injektion in pseudoträchtige Mäuse, was zu zwei unabhängigen Mausstämmen für die Löschung von 923 CNE führte, $923^{del}$ und $923^{large}$. Die Pfeile zeigen die homologe Sequenz (markiert durch ein gepunktetes X) und die LoxP-Stelle (Pfeilspitze) für die CRISPR-vermittelte Rekombination durch die Cas9-Nuklease und gelenkt durch die CRISPR gRNA, die durch die roten und grünen Haarnadelstrukturen unterhalb des Zielortes dargestellt wird.*

Cas9 genome editing in the mouse genome (Fig. 4). Deletion of the 923 CNE resulted in decreased involucrin gene expression in the skin of both $923^{del/del}$ and $923^{large/large}$ mice, thus identifying 923 CNE as an enhancer for the involucrin gene (Fig. 5). Thus far, we have identified a positive selection and near selective sweep for an enhancer haplotype for increased involucrin gene expression in the skin in the CEU population revealing human skin barrier evolution out of Africa.

We next examined the significance of having more involucrin on the skin by performing functional studies in the mouse. It was previously determined that involucrin-deficient mice exhibited normal skin barrier development, and it was revealed that involucrin is not required for developing the skin barrier (Djian et al. 2000). This led us to test the alternative hypothesis for involucrin to maintain skin homeostasis in the adult mouse. To test this hypothesis, we examined the skin homeostatic response in involucrin-deficient and wild-type control mice by treating their ear skin with MC903, a vitamin D agonist that induces skin inflammation (Schmidt et al. 2023). After 16 days of daily MC903 treatment, we found that involucrin-deficient mice exhibited a decreased response to MC903-induced inflammation compared to control wild-type mice. To better understand

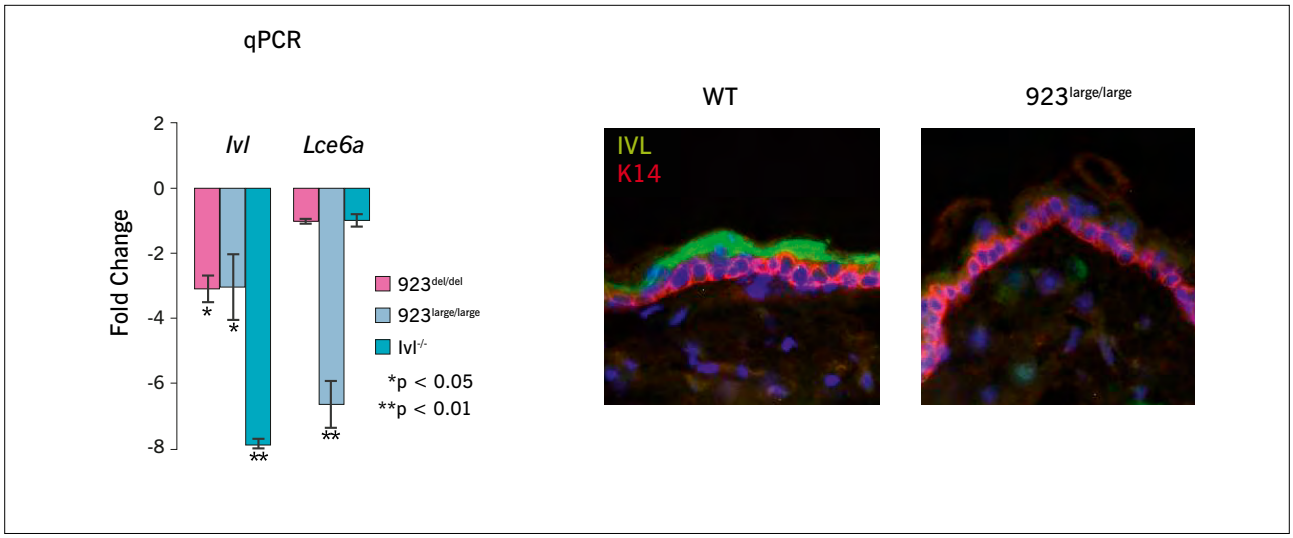



**Fig. 5** Loss of involucrin gene *(Ivl)* gene expression in newborns skin of both $923^{del/del}$ and $923^{large/large}$ mice compared to control wild-type mice as determined by quantitative PCR (qPCR) and further validated by immunofluorescent microscopy for loss of involucrin protein expression (green) in $923^{large/large}$ mouse skin with keratin 14 (K14, red) expression. *Lce6a* gene expression was also significantly decreased in newborn skin of $923^{large/large}$ mice as this gene was also deleted. p values < 0.05 shown to demonstrate significance.

***Abb. 5*** *Verlust der Involukrin* (Ivl) *[A2]-Genexpression in der Haut von sowohl Neugeborenen $923^{del/del}$ als auch $923^{large/large}$ Mäusen im Vergleich zu Wildtyp-Kontrollmäusen, bestimmt durch quantitative PCR (qPCR) und weiter validiert durch Immunfluoreszenzmikroskopie für den Verlust der Involukrin-Proteinexpression (grün) in der Haut von $923^{large/large}$ Mäusen mit Keratin 14 (K14, rot) Expression. Die Expression des Gens* Lce6a *war in der neugeborenen Haut von $923^{large/large}$-Mäusen ebenfalls signifikant verringert, da dieses Gen ebenfalls gelöscht wurde. p-Werte < 0,05 zeigen die Signifikanz.*

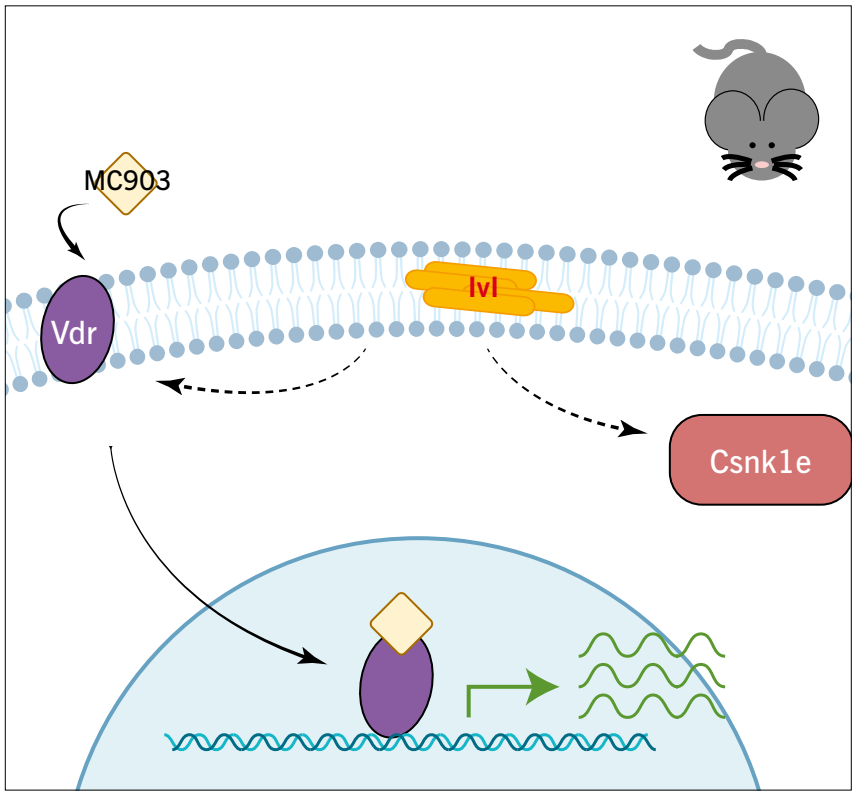



**Fig. 6** Schematic of our MC903 mouse study that identifies a role for involucrin *(Ivl)* to positively regulate Vitamin D receptor (Vdr) function to localize to the nucleus and activate gene expression (shown in green wave lines), a biological activity that was lost in Involucrin-deficient mice.

***Abb. 6*** *Schematische Darstellung unserer MC903-Mausstudie, die zeigt, dass Involukrin* (Ivl) *die Funktion des Vitamin D-Rezeptors (Vdr) positiv reguliert, um sich im Zellkern zu lokalisieren und die Genexpression zu aktivieren (dargestellt in den grünen Wellenlinien), eine biologische Aktivität, die bei Involukrin-defizienten Mäusen verloren gegangen ist.*

why involucrin-deficient mice failed to respond to MC903, we performed single cell RNA sequencing (scRNA-seq) on MC903-treated ears to determine the gene expression profile at the single cell level and their differences between involucrin-deficient and control wild-type mice. Our bioinformatic analyses of scRNA-seq identified a significant reduction in Vitamin D receptor expression in many of the keratinocyte clusters. Our finding reveals a role for involucrin in regulating vitamin D receptor expression in keratinocytes (Fig. 6).

We next sought to determine the relevance of this putative relationship between involucrin and vitamin D receptor in light and dark-pigmented human foreskin samples with the goal of understanding the significance of having more involucrin for human skin barrier evolution. Here, we found a direct yet inverse relationship between involucrin and vitamin D receptor expression with respect to human skin pigmentation that was used as a proxy for CEU haplotype (light pigmentation). Involucrin and vitamin D receptor gene expression decreased as pigmentation increased in human foreskin samples (Fig. 7). Decreased vitamin D receptor was also observed in the normal skin and keloid scars of Black individuals compared to White individuals (Hahn/Supp 2017), which further demonstrates an inverse correlation between involucrin and vitamin D receptor with pigmentation. Indeed, future studies are needed to best determine a more direct relationship for vitamin D receptor expression with respect to involucrin CEU haplotypes.

In summary, our genomic studies in modern human populations and functional studies in mice identify evolution of the human skin in Northern Europe to have more involucrin and its significance in impacting vitamin D receptor function. Yet these results also raise an important question: When did this occur? We performed a preliminary analysis that suggests this derived haplotype for more involucrin in European skin likely emerged in modern humans. For example, SNP rs4845327-G is found in the positively selected haplotype in Europe and is not reported in the genomes of the archaic Denisovan and four Neandertal individuals that have been sequenced to date (Briggs et al. 2007; Green et al. 2010). However, this SNP allele is also found in modern human populations in Africa and, as described by our study, is found in a haplotype that reached a near selective sweep in European populations. These findings suggest the emergence of this allele to have occurred in modern humans after the divergence of Denisovan and Neanderthal and likely prior to the human migration out of Africa that occurred approximately 50 000 years ago. This approximation also leads us to surmise that this allele for more involucrin was present in Neolithic humans who likely had darker skin and was positively selected in a haplotype that arose over time as humans migrated into Europe. To date and to our knowledge, no other SNPs have been reported to be associated with increased involucrin and are not in this positively selected CEU haplotype. This is of great significance as it suggests that this human haplotype was likely a single event in modern human history that was positively selected in recent history. The alternative explanation is the emergence of multiple and independent genetic events for increased involucrin that is less likely. The causative SNP(s) for this increased expression for involucrin in this haplotype has yet to be determined. Indeed, it is interesting to speculate that the emergence of having more involucrin in modern humans in Africa may have coincided with and perhaps compensated for the succeeding loss of body hair.

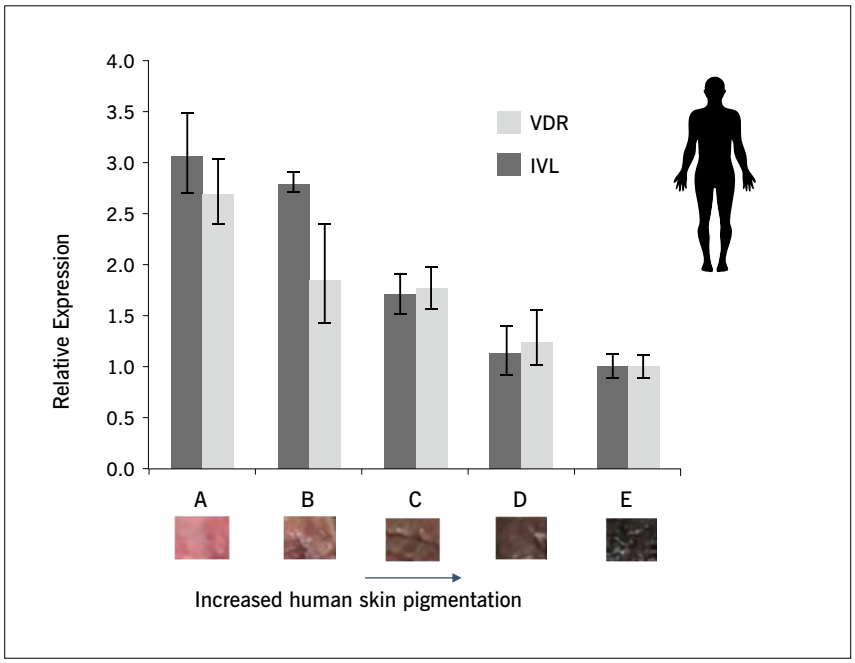



**Fig. 7** A direct inverse relationship between involucrin and vitamin D receptor and human skin pigmentation (proxy for CEU vs. YRI ancestral skin). IVL and VDR gene expression decreases as pigmentation increases in human foreskin samples.

***Abb. 7*** *Eine direkte umgekehrte Beziehung zwischen Involukrin und dem Vitamin-D-Rezeptor und der menschlichen Hautpigmentierung (stellvertretend für CEU vs. YRI-Haut menschlicher Vorfahren). Die IVL- und VDR-Genexpression nimmt mit zunehmender Pigmentierung in menschlichen Vorhautproben ab.*

Furthermore, ours and several other evolutionary studies are beginning to understand that the human skin has adapted to different regions around the world. The observation of increased skin pigmentation in populations that live near the equator attests to the selection of darker pigmentation as a human adaptable trait in regions with high solar irradiation exposure (Jablonski/Chaplin 2010). Our findings for the genetics for more involucrin highlight the innovation of the human genome and its selection as an adaptative feature to the environment to appropriately ›clothe‹ the human body. As higher involucrin is correlated with higher vitamin D receptor expression, this conserved relationship in the mouse and highly associated with lighter vs dark pigmented skin further reveals a potential titration of the skin by involucrin to be environmentally responsive. Future studies are ongoing to determine the biological significance of having more involucrin ›clothing‹ with respect to environments of Northern European latitude and the mechanism by which involucrin regulates the vitamin D receptor.

Additionally, the loss of terminal body hair is another example of human skin adaptation. Two current models are proposed as negative selection pressures to retain body-wide hair in contrast to our ancestors (Wheeler 1984; Pagel/Bodmer 2003). It has been proposed that the loss of body hair prevented the ability of lice to properly inhabit the human host and thus mitigate its potential as a vector for infection (Pagel/Bodmer 2003). As modern humans became bipedal and began to hunt, another model was suggested for the loss of body-wide hair: it facilitated an increased demand for more adaptive thermal regulation (Wheeler 1984). How does the emergence of exogenous clothing factor into our evolutionary timescale for human skin adaptation? Rogers et al. posited that hairlessness likely emerged prior to the use of clothing (Rogers et al. 2004), given that there is no evidence to date for hide scraping prior to 300 000 years ago, nor even for clothing before 20 000 years ago. This contrasts with an earlier dating of human thermoregulatory hairlessness that may have coincided with humans as hunters at least 400 000–2.5 million years ago. Thus, the likelihood of clothing predating hairlessness is low and therefore unlikely to be a selective pressure for human skin evolution. Yet as humans physically clothed themselves, their covered skin sites likely adapted (not evolved) to the frictional forces or thermoprotection of exogenous clothing. These biological responses are akin to a wound-healing response in that they are reversible and not heritable, and thus not evolutionarily constrained. Nevertheless, these current models and their dating indicate that clothing was not likely a selective pressure for hairlessness but rather an innovative strategy that probably occurred after humans lost their terminal body hair. We further reason that the near selective sweep of more involucrin ›clothing‹ likely represents an even more recent event in modern human evolution. We anticipate more accurate dating and assessments of future archaeological findings with newer technologies to better reconstruct our understanding of modern human evolution with respect to skin adaptation and clothing.

## Acknowledgements

I thank former lab members, Inez Oh, Mary Elizabeth Mathyer, Alina Schmidt, and Erin Brettmann for generating figures and current lab member, Niharika Srivastava, for figure formatting.

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# Human evolution and the origins of Stone Age clothing

Olaf Jöris

**Zusammenfassung**

Die Evolution des Menschen und die Ursprünge der Kleidung in der Steinzeit

*Das ›Standardnarrativ‹ zur Entwicklung der menschlichen Kleidung sieht deren Entstehung in erster Linie im Zusammenhang mit der Anpassung an klimatische und ökologische Bedingungen, wonach sie im Wesentlichen der Thermoregulation des menschlichen Körpers dient. Mit der Zeit scheinen sich die funktionalen Aspekte der Kleidung jedoch zunehmend in Richtung sozial bedingter Gründe für das Bekleiden des Körpers zu verschieben. Der vorliegende Beitrag untersucht die wissenschaftlichen Belege für den evolutionären Verlust der menschlichen Körperbehaarung, kombiniert dabei Daten aus verschiedenen Disziplinen, darunter molekulargenetische Untersuchungen an Menschen und Läusen, überprüft die archäologischen Belege für die früheste Besiedlung der höheren Breitengrade und hinterfragt – durch die Diskussion der Zusammenhänge zwischen den verschiedenen disziplinären Ansätzen – die Gültigkeit des ›Standardnarrativs‹. Der vorliegende Beitrag diskutiert eine Reihe von Vorannahmen, die den meisten Interpretationen zugrunde liegen und die hauptsächlich durch die verzerrte, selektive Überlieferung vergänglicher Materialien in den älteren Steinzeiten geprägt werden. Er kommt zu dem Schluss, dass die Frage, wann Kleidung erstmals aufkommt, weitgehend unbeantwortet bleiben muss, weist jedoch darauf hin, dass Kleidung möglicherweise viel tiefer in der menschlichen Vergangenheit verwurzelt ist als allgemein angenommen, und schlägt vor, dass Textilien der Erfindung der Lederbekleidung vorausgingen.*

**Schlagwörter** Thermoregulation, menschliche Ektoparasiten, Molekulargenetik, Kälteanpassung, Zerrbilder aufgrund von leicht vergänglichen Materialien

**Summary**

*The ›standard narrative‹ of the evolution of human clothing sees its emergence primarily in the context of an adaptation to climatic and environmental constraints, basically serving issues of thermoregulation of the human body. With time, the functional aspects underlying clothing seem to shift towards socially induced reasons for clothing oneself. This contribution reviews the scientific evidence for the evolutionary loss of human body hair, combining data from different disciplines including human- and louse-genomic studies, reviews the archaeological evidence for the earliest occupation of the higher mid-latitudes, and – by discussing the interlinkages between the different approaches – questions the validity of the ›standard narrative‹. The present contribution addresses the massive biases underlying most interpretations, which are mainly hampered by the poor preservation of perishable materials in early Stone Age periods. It concludes that the question of when clothes were first invented remains largely unanswered but indicates that clothing may be much more deeply rooted in the human past than generally assumed, and proposes that textiles preceded the invention of leather clothing.*

**Keywords** Thermoregulation, human ectoparasites, genomics, cold adaptation, preservation biases of perishable materials

## From the »Naked Ape« …

Described as »naked apes« (Morris 1967), modern humans *(Homo sapiens sapiens)* are the representatives of the only species in the Primate order that is not fully covered in hair. Why and when modern human ancestors lost their fur and evolved near-naked skin is a matter of intensive scientific debate (e.g. Best et al. 2019), but most likely this process was triggered by multiple drivers.

The near complete absence of body hair that characterises human skin arrives together with major changes in the fabric and function of epidermal and deeper-layered tissues: An extremely high body surface cover of eccrine sweat glands and their high density are characteristics of human skin – unparalleled in other species in the Primate order (Best/Kamilar 2018) – and allow for enhanced thermoregulatory capacities of the human body (see discussion in Notely et al. 2024). It is argued that the related capaci-

ties for sweating were essential to perform »high physical activity in open, hot, semi-arid environments« (Best et al. 2019, 331; cf. Blumenthal et al. 2017) like the African savannahs, where food resources were widely dispersed. Roughly between 1.8 and 1.5 million years ago, these epidermal changes seem to have co-evolved with a near-modern human skeletal architecture and body stature (e.g. Wang/Crompton 2004; Haeusler et al. 2011; Holliday 2012), which – together with enhanced sweating capacities (Best et al. 2023) – would have enabled endurance running and therewith persistence hunting, an important strategy practiced amongst many contemporary hunter-gatherers to successfully drive prey into heat exhaustion (Bramble/Lieberman 2004; Liebenberg 2006).

In addition, genetic studies of the variation at the melanocortin 1 receptor (MC1R) locus (known to produce a protein that affects the pigmentation of skin and hair, studied in different human populations and compared with chimpanzee data) allow age-modelling of the timing when humans may have lost their body hair (Rogers et al. 2004). The genetic data analysed hint at the »adoptive evolution for sun-resistant MC1R alleles« in early human evolution (Rogers et al. 2004, 105). Based on their calculations, Rogers and colleagues suggest that ancestral humans »have been hairless savannah-dwellers for at least 1.2 million years« (Rogers et al. 2004, 107; cf. Fig. 1: centre, red typo). However, the mathematical models employed to explain today's genetic variability depend on the assumed size of an initial African population in which mutations appeared successively. But the authors also assert: »No matter how large we imagine the African population to have been, we will not conclude that the most recent selective sweep occurred less than 560 000 years ago« (Rogers et al. 2004, 107). With reference to the paucity of material evidence for clothing preserved from the Palaeolithic, they further state »that humans were naked before they were clothed« (Rogers et al. 2004, 107)[1].

## … to the first dressed humans?

As mentioned above, the evolution of modern human hairlessness most likely had multiple drivers. Pagel and Bodmer (2003) argue that ectoparasite loads would have been reduced as a result of evolving human hairlessness. In consequence, the spread of related diseases would be limited, and survival enhanced. According to these authors, with the dedicated deployment of clothes, human-built dwellings, and the controlled use of fire, the lack of the protective properties of body hair could have been compensated for. Furthermore, it would have been easily possible to clean clothes and shelters »if infested with parasites« (Pagel/Bodmer 2003, S117) largely abandoning them. Clothes, dwelling structures and the habitual use of fire would have further paved the way for early human geographical expansion into climatically less favourable and mostly colder regions (cf. Gilligan 2010).

However, despite a few early indications for the use of fire (e.g. Alperson-Afil 2008), at present it seems that its controlled use did not become regular practice significantly before ~400 ka[2] (Roebroeks/Villa 2011; Roebroeks et al. 2021). Even the much younger, dense Upper Pleistocene archaeological record of Ice Age Europe still shows that fire was not in constant use (e.g. Dibble et al. 2017; Murphree/Aldeias 2022). Arguments for the earliest appearance of clothing are even less straightforward, as perishable materials rarely survive in the archaeological record (see review in d'Errico 2024; cf. Gilligan 2010, and a series of papers in this volume). Similarly, unambiguous evidence for shelter-like dwelling structures (cf. Barham et al. 2023) does not exist until quite recently (e.g. Nadel 2003), demanding critical evaluation of potential features and structures (Kolen 1999).

Nevertheless, even with the more regular use of the above (protective) technologies, humans never rid themselves fully of parasites (Boutellis et al. 2014). It is only since the (late) Middle Pleistocene/early Upper Pleistocene that new parasites appeared: the human clothing louse (Fig. 1: left, violet), which diverged from human head louse ancestors between roughly 691 000 and 29 000 years ago (at 95 % probability density), according to statistical modelling of available DNA data of recent lice (Toups et al. 2011). An age-estimate of 83 ka has been calculated for the highest posterior probability for this divergence, a median of 170 ka and a mean value of 229 ka (Toups et al. 2011). The lice DNA data further suggest »that the use of clothing likely originated with anatomically modern humans in Africa« (Toups et al. 2011, 29). This is argued to be in line with other developments toward the evolution of human »behavioural modernity« around the Middle to Upper Pleistocene transition, »including the increasing use of ochre for various protective and symbolic purposes and the production of personal ornaments«, suggesting »that these practices were well established [in Africa] by at least 160 000 to 140 000 years ago« (d'Errico 2024).

## A need for clothing in the Ice Age cold?

The genetic data indicate that ancestral humans most likely lost their body hair either in the late Early Pleistocene or, at the latest, in the early Middle Pleistocene (Rogers et al. 2004), i.e. around the Mid-Pleistocene Transition (MPT), a period between ~1.25 million years and 750 ka ago (Fig. 1) during which the global climate system slowly changed from the roughly 40-kyr[3] cyclicality of glacial-interglacial cycles to the present period – characterised by 100-kyr cyclicality – with more pronounced differences between longer glacial (even numbered Marine Isotope Stages [MIS]) and shorter interglacial (odd MIS numbers) climate conditions (e.g. Herbert 2023).

At the present state of knowledge, early humans had already expanded northwards, beyond the limits of the

1 A much earlier date for the loss of body hair (~3.3 million years ago) has been proposed based on the origin of pubic lice in humans (Reed et al. 2007; cf. Gilligan 2010).

2 ka = kilo annum (i.e. 1000 years).

3 kyr = kilo year (i.e. 1000 years), here used exclusively for the astronomical age-scale.

African continent, by more than ~2.1 million years ago, quickly reaching eastern Asia (Zhu et al. 2018), and moving into the southern half of Europe (here, defined as south of ca. 47.5°N) probably as early as 1.7–1.3 million years ago (e.g. Arzarello et al. 2007; Berto et al. 2024; López-García et al. 2015)[4], but at the latest by ~1.4–1.2 million years ago[5]. According to population modelling, the northern half of Europe north of the Alps may have been occupied soon thereafter – between 1.16 million years and 913 ka ago (Key/Ashton 2023; cf. Despriée et al. 2024). The first archaeological evidence north of 47.5°N, i.e. in the northern mid-latitudes (Fig. 1: centre section), dates to ~950 ka (MIS 25) or ~850 ka (MIS 21), with Happisburgh 3 in eastern England being the only securely dated late Early Pleistocene site in primary context located this far north (Parfitt et al. 2010; Ashton et al. 2014)[6]. Potentially further evidence for an early ancestral human settlement this far north, dating around 800 ka (MIS 19) or ~700 ka (MIS 17), comes from a few localities nearby (Parfitt et al. 2005; Key/Ashton 2023).

Whereas the above northern European evidence for early human occupation is exclusively linked to interglacial contexts, the site of Moulin Quignon in northern France, which produced amongst the earliest Acheulean tools in Europe, has been dated to between 670 ka and 650 ka and falls in the beginning of MIS 16, representing the first northern European archaeological site that provides evidence for human presence under cold climatic conditions (Antoine et al. 2019). It was probably the ability to cope with such cold conditions that was required for a more persistent human presence in the north that can neither be traced before MIS 15–13 in Europe (Jöris 2014; cf. Key/Ashton 2023), nor in northern Asia.

The Early and Middle Pleistocene dispersals of ›super-archaic‹ and ›archaic‹ humans across Eurasia further led to their (genetic) divergence from ancestral human populations (Fig. 1: centre; cf. Bergström et al. 2021). Genetic differences between the Middle Pleistocene archaic humans and modern humans make it possible to distinguish the Neanderthals, which were spread across western Eurasia, from the so-called Denisovans in the east (see Zeberg et al. 2024). Most importantly, given the overall genetic similarities between the three groups, Zeberg et al. emphasise »that the genetic basis of what constitutes a modern human is best thought of as a combination of genetic features, where perhaps none of them is present in each and every present-day individual«, resulting from repeated and considerable admixture between these populations (e.g. Zeberg et al. 2024; Bergström et al. 2021).

Calculated through statistical analysis of nuclear DNA variability, the major split between archaic and modern human populations has been estimated to have taken place between ~765 ka and 550 ka (Meyer et al. 2016; Prüfer et al. 2014) or between ~630 ka and 520 ka (Prüfer et al. 2017)[7], with Neanderthals and Denisovans diverging from each other more than 430 000 years ago (Meyer et al. 2016; cf. Prüfer et al. 2014).

A more recent study of mitochondrial DNA variation, however, highlights that the age estimate for the most recent common ancestor of both modern humans and Neanderthals, who is supposed to pre-date the population divergence, may have lived closer to 400 ka (Levinstein Hallak/Rosset 2024; cf. Endicott et al. 2010; Rieux et al. 2014)[8]. In contrast to this late date, Levinstein Hallak and Rosset (2024) further calculate an age of ~841 ka for the most recent common ancestor of modern humans and Denisovans.

## Cold adaptation vs. protective clothing?

In conclusion, the combined data compiled seem to confirm the idea that archaic humans did indeed expand across Eurasia well after having lost their hair (Rogers et al. 2004), during a time of increasing climatic harshness in northern latitudes (see above). With regard to the question of whether archaic humans required clothing to survive in the higher mid-latitude regions of Eurasia, it should be discussed to what degree they managed to cope with cold climate environments (Gilligan 2010). Although Neanderthals appear to have clearly preferred warmer habitats (e.g. Serangeli/Bolus 2008; Jöris et al. 2022), many aspects of Neanderthal physical anatomy (e.g. Buck et al. 2018; see discussion in Rae et al. 2011) and physiology (e.g. Steegmann et al. 2002) have been interpreted in favour of having been »hyper-adapted to living in cold environments« (Ocobock et al. 2021, and discussion thereof cf. Churchill 2006). However, our still limited understanding of the relationships between physical features (skeletal and body morphology), physiological processes (metabolism and energetic flows from diet to digestion), and the behavioural underpinnings of human lifeways, call for caution in the interpretation of cold-

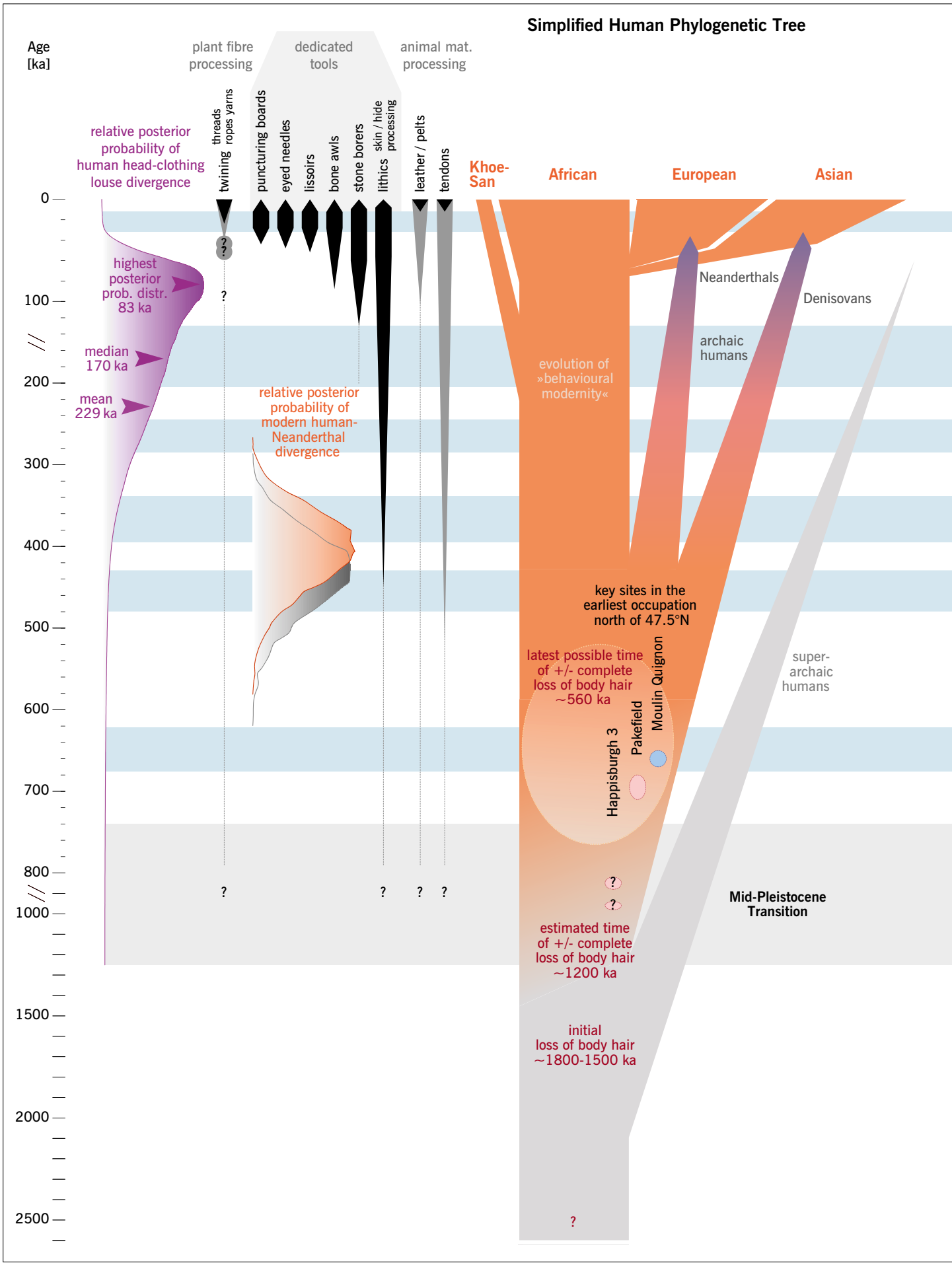
4 For a younger age estimate of the Pirro Nord lithic and faunal assemblages, see Duval et al. 2024, assigning the assemblages a maximal age of ~800 ka.

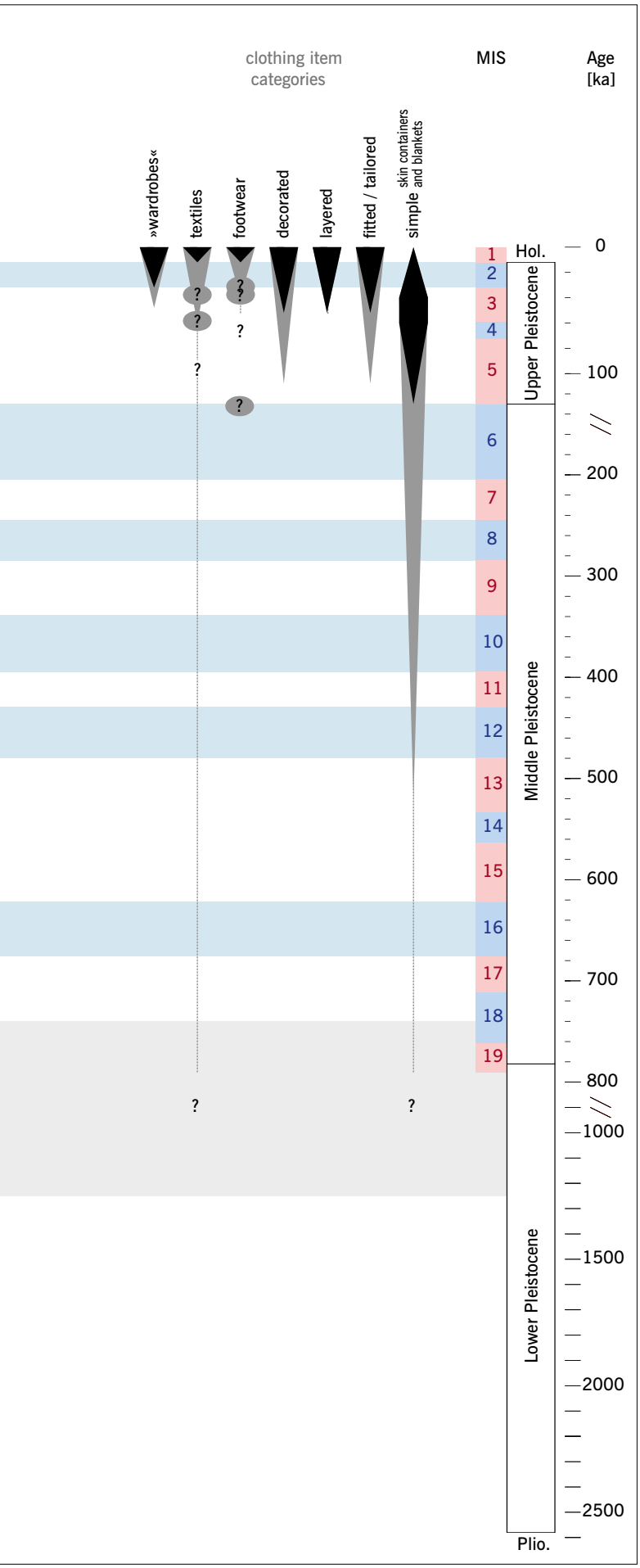
5 E.g. Huguet et al. 2017; Huguet et al. 2025; Blain et al. 2016; Lozano-Fernández et al. 2015; Despriée et al. 2024. Claims for an early human presence at the west Ukrainian site of Korolevo near ca. 48°N some ~1.4 million years ago (Garba et al. 2024) must be regarded critically (Demidenko 2024).

6 Note that some scepticism concerning the age of the site remains, claiming an age of < 600 ka (Westaway 2011).

7 These estimates are roughly in line with earlier metagenomic studies that concluded that Neanderthals and modern humans »share a most recent common ancestor ~706 000 years ago, and that the human and Neanderthal ancestral populations split ~370 000 years ago, before the emergence of anatomically modern humans« (Noonan et al. 2006, 1113). Similar calculations have been deduced in a study of Neanderthal Y-chromosome DNA, indicating that the most recent common ancestor between Neanderthals and modern humans lived around 588 ka (95 % confidence interval, ranges between 806 ka and 447 ka; Mendez et al. 2016).

8 Detailed studies of early human dental morphology point towards a much older age estimate for the last common ancestor of Neanderthals and modern humans (Gómez-Robles 2019). Áida Gómez-Robles argues that dental evolution would have been unexpectedly rapid, if one assumes a divergence of Neanderthals and modern humans later than ~800 ka ago. Respecting an average speed for changes in dental morphology, the best age estimate would place the last common ancestor of Neanderthals and modern humans between ~850 ka and 1.2 million years ago. In good agreement with these age estimates are the results of geometric-morphometric studies aimed at understanding the phylogenetic position of the c. one-million-year-old Yunxuan cranium, China, that hint at ages between ~1.0 and ~1.4 million years ago for the respective divergences of Neanderthals and Denisovans from modern humans (Feng et al. 2024).


Simplified Human Phylogenetic Tree
Age [ka]
plant fibre processing
dedicated tools
animal mat. processing
threads
ropes
yarns
twining
puncturing boards
eyed needles
lissoirs
bone awls
stone borers
skin / hide processing
lithics
leather / pelts
tendons
relative posterior probability of human head-clothing louse divergence
highest posterior prob. distr. 83 ka
median 170 ka
mean 229 ka
relative posterior probability of modern human-Neanderthal divergence
Khoe-San
African
European
Asian
Neanderthals
Denisovans
archaic humans
evolution of »behavioural modernity«
key sites in the earliest occupation north of 47.5°N
latest possible time of +/- complete loss of body hair ~560 ka
Moulin Quignon
Pakefield
Happisburgh 3
super-archaic humans
Mid-Pleistocene Transition
estimated time of +/- complete loss of body hair ~1200 ka
initial loss of body hair ~1800-1500 ka
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500




adapted features (Pomeroy 2023), as the chain of reasoning may easily become circular in that it follows the (logical) line of arguments emphasising that life in the north would demand cold adaptation, which should be expressed in biological as well as in cultural features.

Based on ethnographic data from recent modern hunter-gatherers, Nathan Wales (2012) has argued in this direction, emphasising that the surface of the body covered by clothes increases, the lower the mean temperatures of the coldest month become. For the colder intervals of the last glacial cycle, the study predicts that some Neanderthal pop-

**Fig. 1** Simplified model of human phylogeny, based on combined genetic studies (centre; modified from Pimenoff et al. 2017), illustrating the divergence of super-archaic and archaic humans – the latter represented by Neanderthal and Denisovan populations – from (recent) modern humans (the oval ranging from 765 ka to 520 ka marks the split between modern human and archaic human populations according to nuclear DNA studies of Meyer et al. [2016] and Prüfer et al. [2014; 2017]), compared with posterior probability age estimates for the divergence of modern humans and Neanderthals (after Endicott et al. 2010, with two age estimates based on different models of the human-Chimpanzee divergence, sometimes assumed to date 6–7 million years ago [orange graph], another time assumed to date 6.5–7.5 million years ago [grey graph]) and for the divergence between human head and clothing lice (left, violet: modified from Toups et al. 2011). The genetic data are compared with well-proven (black) and potential (grey) evidence for different tools and technologies involved in the production of clothes shown as vertical time bars to the left of the phylogenetic tree, and with clothing items or categories shown to its right (in analogy to and modified from d'Errico 2024 and Gilligan et al. 2024 and various further sources, for details see text). Data are plotted against a vertical timeline of the Pleistocene (furthest right), bracketed between the late Pliocene (Plio.) and the Holocene (Hol.). The Mid-Pleistocene Transition between ~1.25 million years and 750 ka ago (Herbert 2023) is highlighted, as well as the record of Middle Pleistocene climate change (Lisiecki/Raymo 2005) of glacial (even numbered Marine Isotope Stages [MIS], shown in blue) and interglacial periods (odd numbered MIS, shown in red). The most severe glacial periods are highlighted as blue horizontal bars. Note that the age axis (vertical) changes twice at around 150 and 900 ka. Further explanations are given in the text.

***Abb. 1*** *Vereinfachtes Modell der menschlichen Stammesgeschichte, basierend auf kombinierten genetischen Studien (Mitte; modifiziert nach Pimenoff et al. 2017), das die Abspaltung ›super-archaischer‹ und ›archaischer‹ Menschen – letztere vertreten durch Neandertaler und Denisova-Menschen – von der Linie, die letztlich zu uns modernen Menschen führte, veranschaulicht (das Oval von vor 765 ka bis zu 520 ka markiert die Trennung von modernen und archaischen Menschen gemäß Kern-DNA-Untersuchungen von Meyer et al. [2016] und Prüfer et al. [2014; 2017]), verglichen mit Modellierungen des Zeitpunktes, nach dem die Divergenz von modernen Menschen und Neandertalern erfolgt sein dürfte (nach Endicott et al. 2010, mit zwei Altersschätzungen, die auf unterschiedlichen Modellen der genetischen Trennung von Chimpansen und modernen Menschen basieren, für die einmal ein Alter von 6–7 Millionen Jahren angenommen wird [orangefarbener Graph], ein anderes Mal ein Alter von 6,5–7,5 Millionen Jahre [grauer Graph]), und für die Trennung zwischen menschlichen Kopf- und Kleiderläusen (links, violett: modifiziert nach Toups et al. 2011). Die genetischen Daten werden mit gesicherten (schwarz) und potenziellen (grau) Belegen für verschiedene Werkzeuge und Technologien zur Herstellung von Kleidung verglichen, die als vertikale Zeitbalken links vom Stammbaum dargestellt sind, sowie mit Kleidungsstücken oder -kategorien, die rechts davon dargestellt sind (in Anlehnung an und modifiziert von d'Errico 2004 und Gilligan et al. 2024 sowie verschiedenen weiteren Quellen; Details siehe Text). Die Daten sind auf einer vertikalen Zeitachse des Pleistozäns (ganz rechts) dargestellt, das zwischen dem späten Pliozän (Plio.) und dem Holozän (Hol.) liegt. Der klimatische Wechsel am Übergang vom Frühen zum Mittleren Pleistozän zwischen ~1,25 Millionen Jahren und 750 ka vor heute (Mid-Pleistocene Transition: Herbert 2023) ist hervorgehoben, ebenso wie der wechselhafte Gang des Klimas im Mittleren Pleistozän (Lisiecki/Raymo 2005) mit Glazialen (gerade nummerierte Marine Isotope Stages [MIS], blau dargestellt) und Interglazialen (ungerade nummerierte MIS, rot dargestellt). Die strengsten Glazialperioden sind als blaue horizontale Balken hervorgehoben. Zu beachten ist, dass sich die Altersachse (vertikal) zweimal um 150 ka und 900 ka ändert. Weitere Erläuterungen finden sich im Text.*

ulations »would have covered up to 80 % of their bodies during the winter« months, likely including covering their hands and feet (Wales 2012, 781). Even though one is willing to follow the logic behind this argument, it is important to remember that empirical data in support of this hypothesis are scarce or even completely lacking. On the contrary, numerous foot imprints have been preserved at different Pleistocene sites throughout Eurasia (cf. Pastoors/Lenssen-Erz 2021 for an overview). Whenever their morphology is preserved at a high level of detail, which depends on the conditions during which the imprint formed (sediment grain size distribution, moisture content, etc.) and its taphonomic alterations thereafter (cf. Ledoux et al. 2021a), it is clear that the imprints generally represent individuals walking barefoot, lacking any type of footwear. The oldest hominin foot imprints preserved in Europe have been documented at Happisburgh in England (Ashton et al. 2014; Ashton 2021) – only 140 m distant from the locality that lays claim to the earliest occupation of northern Europe (see above): all bare feet. For pre-modern humans, only in a single case – Theopetra Cave in Greece, dating some ~130 000 years ago (Kyparissi-Apostolika/Manolis 2021) – were arguments put forward in favour of Neanderthal use of footwear.

Assuming that the foot imprint record does not stem exclusively from warm-climate warm seasons, one tends to argue against Wales' (2012) prediction. To the contrary, based on the footprint evidence, one would have to claim that the invention of footwear as thermal protection should have been a late invention. This is supported by noticeable differences in anatomical features of archaic and modern human phalanges, indicating that »supportive footwear was rare in the Middle Paleolithic, but that it became frequent« by the Upper Palaeolithic (Trinkaus 2005, 1515; Trinkaus/Shang 2008; cf. Trinkaus et al. 2021[9]). This claim is largely in line with some of the footprint evidence, hinting at the use of footwear during the mid-Upper Palaeolithic, well-studied in the cave of Cussac in France (Ledoux et al. 2021b; cf. Ledoux et al. 2021a).

The potential differences in footwear use between archaic and modern humans are mirrored in claims for differences in clothing (Collard et al. 2016) and closely follow the idea that archaic humans were equipped with simple, »probably [...] non-tailored clothing« (Wales 2012), whereas the ›standard narrative‹ says that mid-Upper Pleistocene modern humans wore more elaborate and sophisticated, fitted, tailored, probably layered and – most likely – decorated dresses (e.g. d'Errico 2024; Gilligan et al. 2024; Trinkaus/Buzhilova 2018). This feeds into the general view that ›proper‹ clothing was invented comparably late (cf. Toups et al. 2011 and discussion above) and that archaic humans were not so well adapted to meet the challenges that life in cold environments confronted them with (Gilligan 2007). However, the evidence for fitted, tailored, layered, and decorated clothing cannot be read only in terms of thermal insulation, as many aspects of sociality are interconnected with the types, ways, and many reasons why humans dress (e.g. Gilligan in this volume; d'Errico 2024).

Even though clothing fulfils multiple (social) purposes, it – of course – preserves functional aspects, as was central in Wales' (2012) study. In this context it is important to mention that recent modern humans display metabolic and insulative properties indicative of a »whole body cold adaptation« (Daanen/Van Marken Lichtenbelt 2016; cf. Hill 2023), allowing regulation of the body's heat balance through a range of processes that relate to specific physical and physiological properties of the human body (Daanen/Van Marken Lichtenbelt 2016; Pomeroy 2023). Brown adipose subcutaneous tissue and skin pigmentation play among the major roles in metabolic and insulative cold adaptation and are argued to have dispersed »out-of-Africa« with the dispersal of modern humans (Daanen/Van Marken Lichtenbelt 2016; cf. Ocobock et al. 2021). Following this argument, one may hypothesise that modern humans may be better adapted to a cold climate than archaic humans were. A recent study in three cultures in different regions of the globe in which individuals live (almost completely) naked addressed the metabolic feasibility to cope with cold-season temperatures around ±5° C (Hill 2023). Although their lifestyles are calorically costly, the study shows that basic metabolic rates and metabolic endurances allowed for levels of thermoregulation feasible to overcome periods »significantly longer than 50–180 days per year« (Hill 2003, 182), bridging the cold seasons in the different regions. These data, indeed, indicate that modern humans are well-adapted to get along with cold climatic conditions, and also explain our species' global distribution.

The extent to which archaic humans were equally adapted to sustain such costly metabolisms has been repeatedly discussed (Ocobock et al. 2021). In this context, not only regional climatic conditions need to be considered, but also body mass (Heyes/MacDonald 2015) and skin surface area (Churchill 2006), hinting at elevated basal metabolic rates in Neanderthals compared to modern humans. This would demand significant increases in caloric intake. Although attempted by Wales (2012), the data available at present are still too fragmented to allow for precise estimates of the bioenergetic demands of archaic humans in different climatic and seasonal context, and – as mentioned above – their presence in higher-mid latitudes seems to be restricted to milder or warmer periods (Jöris et al. 2022), rather than severe cold intervals. But genomic studies indicate that Denisovans contributed genetically to the high-altitude adaptation of modern Tibetans as well as to Inuit »adaptation to low temperatures, probably inducing brown fat« (Zeberg et al. 2024, 1052). Although these data provide some strong arguments for archaic humans' cold adaptation, it remains largely unanswered whether or not, and to which degree, they were able to cope with cold cli-

9 For examples of well-preserved younger Stone Age footwear, see Pinhasi et al. 2010 for a Chalcolithic leather-made shoe stuffed with loose grass, found in Armenia (cf. Hafner in this volume); for examples of early plant-fibre-made sandals, see contributions by Maria Herrero-Otal et al. and by Mario Mineo et al. in this volume. For claims of even older fibre-based footwear technologies, see Ollivier et al. 2017.

mate – especially during the cold season of the year – and whether or not they managed to deal with such conditions better than modern humans.

## Deep, unknown roots of clothing?

It is generally assumed that the more elaborate clothes are, the more sophisticated the tools and technologies required for their production will be. This assumption opens the narrative arc in which the evolution of clothing is interpreted as having been ›simple‹ and ›primitive‹ in earlier times, and ›complex‹ and ›fancy‹ in later periods. Both the immense diversity of present-day human clothing and the archaeological record seem to give ample proof of the technical diversification and growing complexity of clothing manufacture over time. Starting with simple stone artefacts interpreted as borers that may have been used in the production of clothes, bone awls and lissoirs used for the perforation and smoothing of animal materials, eyed needles, and ›puncturing boards‹ are most generally interpreted in the context of the manufacture of clothes (d'Errico 2024; Gilligan et al. 2024). But often, the functional interpretation of some of these tool types is merely inferred solely from tool morphology, or is based on use-wear analyses, which are rarely backed by systematic large-scale and comprehensive experimental approaches (as a recent example for analytical progress in this field, see Ma et al. 2023). However, the most straightforward functional interpretation of a tool closely linked to clothing manufacture (but not exclusively reserved for such purposes!) is the eyed needle (d'Errico et al. 2018; Gilligan et al. 2024), even though recent finds hint at the existence of alternative methods for performing sewing tasks well without these enigmatic tools (Doyon et al. 2023). Personal ornaments are also often interpreted as applications sewn onto clothes (cf. d'Errico 2024; Gilligan et al. 2024); of these, the burial contexts at Sunghir in Russia provide the most impressive evidence, highlighting the social relevance of decorated garments (Trinkaus/Buzhilova 2018) that, in some cases, seem to closely resemble the traditional costumes most widespread in rural regions today. The above – to the greatest degree, indirect – evidence speaks of tailored and decorated clothing not before c. 40–50 ka, but hints at possibly much deeper roots when the first personal ornaments are considered as clothing applications, roughly around 100 000 years ago (e.g. Bar-Yosef Mayer 2020), i.e. at around the time when the clothing louse diverged from its head lice ancestors (Toups et al. 2011).

During the last few years, tools that are most generally associated with the production of clothing have been reported more and more frequently from late Middle Palaeolithic contexts (e.g. Soressi et al. 2013; Tartar et al. 2022; cf. Hallett et al. 2021). The same accounts for the use of bird claws and potentially of feathers as personal ornaments[10], which could be applied to clothes as decoration, and which may date back to as early as ~400 ka (Blasco et al. 2019). The evidence of Neanderthal footwear at around 130 ka, already mentioned above (Kyparissi-Apostolika/Manolis 2021), must be listed in this context, as well. Much older, however, is the use-wear evidence of hide processing or evidence for the extraction of tendons, dating back to ~450 ka to 500 ka or slightly older[11], potentially even with much deeper roots (cf. Carbonell et al. 1999).

When compared with the modern human record of clothing, all these data make it highly likely that Neanderthals used tools and materials for clothing production similar to those used and implemented by modern humans. The Neanderthals' tools for clothing manufacture were probably not as standardised as modern human tools were. Nevertheless, the chief reasons why we tend to think they were much simpler and less sophisticated are two-fold: (1) the lack of eyed needles, and (2) the absence of decorated burials, which are both usually interpreted as indicative of simple, not properly fitted, non-tailored clothing, lacking decorative applications (see discussion in Gilligan in this volume; d'Errico 2024; Gilligan et al. 2024). However, this logical, but also simplistic and reductionist view is, to an extreme level, biased by the lack of preservation of perishable materials the farther we look back into the past. In this context, it should be mentioned that the ›standard narrative‹ of the evolution of clothing places the origin of clothes made of animal materials chronologically before the emergence of clothing items made from plant fibres. But plant fibres are rarely preserved in earlier Palaeolithic contexts (e.g. Rots et al. 2015), and our still poor understanding of past plant processing and fibre technologies (see Rots/Tomasso in this volume[12]) hampers a systematic assessment of potentially older fibre-based clothing technologies, including the production of textiles and basketry, as is argued for the mid-Upper Palaeolithic (e.g. Soffer et al. 1998; Soffer et al. 2000; but cf. Valoch 2007 for a critical review), likely involving weaving (Soffer 2004), which is argued to have implications for the sexual division of labour (Soffer/Adovasio 2010; Soffer/Adovasio 2014). As contrasting evidence, only a single pre-Upper Palaeolithic example of twined fibres, interpreted as a cord fragment, has been reported to have been preserved, carbonised on a surface of a lithic artefact from the late Middle Palaeolithic site of Maras in France, dated to 41 000–52 000 years ago (cf. Hardy et al. 2020[13]). One can easily imagine how much our view of the Middle Palaeolithic would change if preservation conditions permitted similar discoveries in earlier periods.

10 Finlayson et al. 2012a; Finlayson et al. 2012b; Fiore et al. 2016; Radovčić et al. 2015; Romandini et al. 2014.

11 E.g. Keeley 1993; Parfitt 1999; Claud et al. 2019; Lemorini et al. 2020; Nicoud et al. 2022.

12 Cf. Conard/Rots 2024 and discussion in Kvavadze et al. 2009; Kvavadze et al. 2010; Bergfjord et al. 2010; cf. Nadel et al. 1994.

13 Criticism of this interpretation presented by Verle Rots and Sonja Tomasso in this volume, is based on questioning the context of the reported processed fibres. The carbonisation of the cord fragment and of other fibre materials in the specific layer is a major argument for their not being intrusive (Hardy et al. 2020).

## Plant fibres at first?

With a more abstract view of the evolution of clothing, it is noteworthy that plant fibres are generally easier to access than faunal materials, lighter to transport, and that their processing requires simpler techniques, which are easier to learn. It is for these reasons that the use of plant materials – e.g. for dwelling and nest building – is also documented in many animal species. Even though many species have evolved protective behaviours for different types of dwelling and shelter, with Chimpanzees and Orangutans, for example, using leaves as ›rain hats‹ to protect against rain or intense sunshine or simply for comfort (e.g. Ingmanson 1996; Wich et al. 2009; Shumaker et al. 2011), clothing is seen as a technology or culture that is only found in humans. As such, the use of clothes is often classified as one of the hallmark behaviours distinguishing humans from animals. Such binary perspectives are deeply rooted in Western scientific reductionist approaches. The distinction of modern and archaic humans is only one of such reductionist concepts. Viewed in an evolutionary timeline, it is not surprising that wearing clothes or not frequently connotes attributes such as ›civilised‹ on the one hand and ›primitive‹ on the other – a dichotomous perspective that places the ›human culture of clothing‹ in opposition to an ›animal's biological nature‹ (see e.g. Brock 2007). ›Proper‹ and elaborate clothing would be expected to have emerged during the evolution of what is frequently called »behavioural modernity« (d'Errico 2024), which rather »originated with anatomically modern humans in Africa« (Toups et al. 2011, 29) than outside this continent in Eurasia, even though the »origins of modern human ancestry« – at present – cannot be securely tied to the African continent (Bergström et al. 2021).

Even if one interprets the divergence of the clothing louse from human head lice as the ultimate evidence for the regular, habitual covering of larger parts of the skin with garments, one should bear in mind that the divergence of the different species begins around the mid-Middle Pleistocene (Toups et al. 2011; Fig. 1: left, violet), indicative of early origins for clothing, and in line with Gilligan (2010) and other authors. But what did these early clothes look like? Given the poor preservation of old perishable material, discussed above, one can only speculate. Nevertheless, if one follows the arguments outlined here, that plant-fibre worked products would have been more easily available, producible, and transportable, one would assume that the origins of clothing are to be found in early textile-working. The 77 000-year-old evidence for potential fibre mats uncovered in South Africa at the site of Sibudu (Goldberg et al. 2009) hints at the production of larger textiles, which did not necessarily serve as clothes in a strict sense of dress, but were used in bedding or shelter. This possibility shows that we must widen our view from the narrow definition of clothing to any production of shelter made of organic materials, be it plant or animal based: the technologies required would be entirely the same, whether they were used as a ›second skin‹ worn directly on the skin, or implemented at a distance to control the micro-climate within a spatially-limited shelter. Mats or blankets would have been relatively easy to produce – not necessarily involving much tailoring – and they could have been used flexibly, for example, as capes, when the situation required. As such, assuming the origins of clothing in plant fibres is a tempting alternative. The first animal-based clothing products may then have mimicked those made of plant materials. But to produce leather or pelt blankets demands deep knowledge of hide preparation and tanning techniques. To acquire the necessary skills and experience would have required some testing and experimentation, which could be more easily performed on small pieces of hide or fur. Smaller pieces of processed leather may have functioned as containers or bags for the transport of objects and liquids – necessary accessories for the highly mobile foragers that evolved in semi-arid environments.

The scenario outlined above would imply that ›clothes‹ – applying a broader definition of processed plant fibre products – would have been well in place before ancestral humans began to dress. This hypothesis aligns well with the genetic evidence for the early loss of body hair before the earliest hint at clothing production appears (see Rogers et al. 2004). Such an interpretation would also mean that the first clothing items, likely mats, blankets, containers, bags, or backpacks, may have developed in Africa, possibly far more than a million years ago, and that technologies expanded and diversified when confronted with the new challenges that early humans were facing in the mid-latitudes (cf. Gilligan 2010).

## Acknowledgements

My sincere thanks go to Oliver Dietrich and Marcel Weiss, both LDA, for fruitful discussions and valuable hints on literature and to Carola Murray-Seegert, Oberursel, and Manuela Schwarz, LDA, for the careful proofreading and improvement of the original manuscript.

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## Source of figures

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# Kleidung und die evolutionäre Bedeutung der Scham

Thomas Junker

**Summary**

Clothing and the evolutionary meaning of shame

*One of the most striking physical characteristics of humans is their naked skin. Except for a few densely hirsute areas on the head, in the armpits and genital area, human hair is barely visible. Nothing similar can be found in any other primate species, and even otherwise, a general reduction of fur is rare in mammals. Once the skin became visible, it could serve as a quick indicator of a person's reproductive status. Conversely, clothing, especially when covering the genitals, can serve to desexualise. In this respect, clothing is also one of the many ways in which culture can restrict sexuality.*

*In the following, I will address the question of why individuals feel shame, why they dress and why the latter is required in many social groups. I will focus in particular on the differences to the body and behaviour of chimpanzees and discuss the extent to which the feeling of shame and the clothing rules are based on the natural mating system of humans or whether they are predominantly cultural inventions.*

**Schlagwörter** Nudity, sexual signals, shame, pair bonding, evolutionary psychology

**Zusammenfassung**

*Eines der auffälligsten körperlichen Merkmale der Menschen ist ihre nackte Haut. Mit Ausnahme weniger dicht behaarter Stellen am Kopf, in den Achselhöhlen und im Genitalbereich sind ihre Haare kaum zu sehen. Bei keiner anderen Primatenart findet man Ähnliches und auch sonst ist bei Säugetieren eine allgemeine Rückbildung des Fells selten. Dadurch, dass die Haut sichtbar wurde, konnte sie zum Schnellindikator für den reproduktiven Status eines Menschen werden. Umgekehrt kann Bekleidung, insbesondere die Bedeckung der Genitalien, der Entsexualisierung dienen. Insofern ist Kleidung auch eine der vielfältigen Möglichkeiten kultureller Beschränkungen auf dem Gebiet der Sexualität.*

*Im Folgenden wird es um die Frage gehen, warum Individuen Scham empfinden, warum sie sich bekleiden und warum letzteres in vielen sozialen Gruppen gefordert wird. Dabei werde ich besonders auf die Unterschiede zum Körper und zum Verhalten der Schimpansen eingehen und diskutieren, inwieweit das Schamgefühl und die Bekleidungsregeln auf das natürliche Paarungssystem der Menschen schließen lassen oder ob es sich überwiegend um kulturelle Neuerfindungen handelt.*

**Keywords** Nacktheit, sexuelle Signale, Scham, Paarbindung, evolutionäre Psychologie

Warum bekleiden sich Menschen, auch wenn es nicht erforderlich ist, um sich vor den Gefahren der Umwelt – vor Sonne, Kälte, Wind und Angriffen – zu schützen? Eine naheliegende Erklärung ist, dass es in vielen Kulturen religiöse und moralische Gebote gibt, die dies fordern. Insofern wäre Bekleidung etwas, das den Individuen von ihrer Gemeinschaft auferlegt wird. Eine ergänzende Beobachtung zeigt, dass Bekleidungsregeln meist strenger und umfassender sind, wenn Menschen in größeren Gruppen zusammenleben. In kleineren und ursprünglichen Gemeinschaften wie bei vielen sogenannten Naturvölkern ist die Bekleidung dagegen oft stark reduziert und manchmal fast nicht-existent (vgl. Eibl-Eibesfeldt 1986, 313–315). Und schließlich fällt auf, dass der Wunsch, sich zu bekleiden und das korrespondierende Schamgefühl erst in einem bestimmten Alter – spätestens mit der Pubertät – auftritt (Hassenstein 1982).

Die Tatsache, dass das Schamgefühl durch Erziehung und Moral verstärkt und modifiziert wird, bedeutet aber nicht notwendigerweise, dass es sich auf kulturelle Konventionen und anerzogene Sozialangst reduzieren lässt. Es könnte auch instinktive Komponenten und evolutionäre Funktionen geben, die dazu führen, dass die Individuen ihren Körper unter bestimmten Umständen freiwillig und aus Eigeninteresse bedecken. Im Folgenden werde ich der Frage nachgehen, was für eine entsprechende biologische Dimension spricht und mich dabei vor allem auf vergleichend-primatologische Beobachtungen beziehen.

## Der nackte Affe

Der unmittelbare Grund, warum Menschen sich bekleiden, ist, dass ihr Körper überwiegend nackt ist. Mit Ausnahme weniger, aber auffallend behaarter Stellen am Kopf, in den Achselhöhlen und im Genitalbereich sind ihre Haare kaum zu sehen. Bei keiner anderen Primatenart findet man Ähnliches und auch sonst ist bei Säugetieren eine allgemeine Rückbildung des Fells selten. Menschen sind zwar nicht völlig haarlos, wie beispielsweise Delphine, sondern ihre Haut ist von zahlreichen winzigen Körperhaaren besetzt. Vom funktionellen Standpunkt aus sind sie aber tatsächlich nackt, da ihre Haut den Einwirkungen der Außenwelt ausgesetzt und sichtbar ist.

Darüber, wann und warum die Reduktion des Fells eingesetzt hat, gehen die Meinungen der Evolutionsbiologen aus-

einander. Die vielleicht plausibelste Theorie postuliert, dass die Nacktheit zusammen mit der Vermehrung der Schweißdrüsen ursprünglich der Regulierung der Körpertemperatur diente: Nackte Haut strahlt Hitze wirksamer ab und die Verdunstung von Wasser beim Schwitzen kühlt den Körper (Ruxton/Wilkinson 2011). Eine leistungsfähige Regulierung der Körpertemperatur wiederum ist eine wichtige Voraussetzung für ausdauerndes Laufen unter Hitzebelastung. Warum aber begannen Menschen über weite Strecken zu laufen, wenn Gehen einfacher, sicherer und weniger energieaufwendig ist? Eine mögliche Erklärung verknüpft das ausdauernde Laufen (endurance running) mit den Ursprüngen der Jagd und der Zunahme tierischer Nahrungsressourcen. Das Merkmal der Haarlosigkeit wäre also bereits vor rund zwei Millionen Jahren bei frühen Menschen *(Homo erectus)* als Anpassung an ausdauerndes Laufen unter Hitzebelastung entstanden (Bramble/Lieberman 2004).

Tatsache ist, dass es im Laufe der Evolution zur Reduktion des Fells kam und damit einhergehend die Haut sichtbar wurde. Dadurch konnte sie zum Signal werden, d. h. zur innerartlichen Kommunikation genutzt werden. So zeigen Menschen ihren emotionalen Zustand – Angst, Wut oder Erregung – nicht durch Aufstellen der Körperhaare, sondern durch Erbleichen oder Erröten. Die Hautfarbe kann auch zur Abgrenzung fremden Gruppen gegenüber dienen (Darwin 1871, Bd. 2, 381). Die Farbe ist aber nur eine von vielen Eigenschaften der Haut. Man kann aus der Haut nicht nur auf Gene, Alter, Ernährung und Gesundheit, sondern oft auch auf charakterliche Eigenschaften, Lebensumstände und den Stresslevel einer Person schließen. Allgemein gibt es vielleicht keinen anderen ähnlich zuverlässigen Schnellindikator für den reproduktiven Status eines Menschen als seine Haut. Dadurch hat sie eine ähnliche Funktion wie die prachtvollen Federn einiger Vogelarten: Sie dient als Indikator für sexuelle Attraktivität (Hejj 1996).

## Multimale-multifemale Paarungssysteme

Ein junges, gesundes und lebenskräftiges Individuum sollte deshalb ein vitales Interesse daran haben, seine Qualitäten zu demonstrieren, indem es sich nackt zeigt (Morris 2005). Da das zentrale Ziel der Partnerwahl die sexuelle Fortpflanzung ist, sollte dies auch für die Sexualorgane selbst gelten. Und es ist zu erwarten, dass die Genitalien vom anderen Geschlecht als begehrenswert empfunden werden. Bei vielen Primatenarten ist das auch der Fall. So ließ sich experimentell zeigen, dass »sexual swellings are visually arousing and attractive to males« (Dixson 2012, 277). Auffällige Sexualschwellungen kommen allerdings nicht bei allen Arten vor, sondern nur in multimale-multifemale Paarungssystemen: »Sexual skin swellings are found in catarrhines, such as some of the macaques, baboons, the talapoin, red colobus monkey, and chimpanzee, all of which have multimale-multifemale mating systems. Swellings are [...] serving to attract multiple partners and thus to encourage the likelihood of sperm competition« (Dixson 2012, 366). In monogamen und polygynen (single-male) Paarungssystemen sind Sexualschwellungen dagegen selten und eher unauffällig.

Am Beispiel der Schimpansen und Bonobos will ich kurz darauf eingehen, wie ein multimale-multifemale Paarungssystem aussehen kann. Die Gruppen bestehen aus durchschnittlich 40 bis 60 Individuen. Die Hälfte davon sind erwachsene Weibchen und Männchen; das Geschlechterverhältnis ist in etwa ausgeglichen. Die empfängnisbereiten Weibchen paaren sich mit fast allen Männchen der Gruppe. Ausgenommen sind nur nahe Verwandte. Ein Weibchen hat also zehn bis fünfzehn Sexualpartner, mit denen es mehrfach in kurzen Abständen kopuliert. Dieses weitgehend wahllose, promiskuitive Paarungsverhalten erfüllt eine wichtige Funktion: Indem sich die Weibchen mit allen Männchen der Horde paaren, geben sie allen die Chance, die Väter zu sein und verhindern so, dass eines der abgewiesenen Männchen ihren Nachwuchs attackiert und tötet (Infantizid; Opie u. a. 2013).

## Das Standard-Modell der menschlichen Evolution

Bei Menschen gibt es diese Form des Zusammenlebens, von Ausnahmen abgesehen, nicht. Stattdessen leben sie überwiegend in Paaren, wobei erfolgreiche Männer in den meisten Kulturen mit mehreren Frauen Kinder haben bzw. nacheinander mehrere Familien gründen können (»serielle Monogamie«). Der Mehrzahl der theoretischen Modelle zufolge hat sich die Paarbindung in der menschlichen Evolution schon vor mehr als zwei Millionen Jahren durchgesetzt. Spätestens zu dieser Zeit begannen die Männer, einzelne Frauen zu begleiten und die Frauen ihrerseits waren ihrem Partner sexuell treu, auch wenn sie andere Optionen hatten. Sobald die Paarbindungen einigermaßen stabil waren, war die Voraussetzung für väterliche Fürsorge in Form von Schutz und Versorgung gegeben (Alexander/Noonan 1979; Gavrilets 2012; Lukas/Clutton-Brock 2013, 527). Damit wiederum war zum einen die materielle Bedingung für die Evolution des Gehirns gewährleistet: eine ausreichende und hochwertige Nahrung. Zum anderen erhielt die Weitergabe der kulturellen Inhalte eine völlig neue Dynamik: Denn jetzt konnten nicht nur die Mütter und Großmütter, sondern auch die Väter und Großväter ihre Erfahrungen und ihr Wissen an die nächste Generation weitergeben. Die romantische Liebe und die Eifersucht beider Geschlechter wiederum haben für die nötige Stabilität gesorgt (Chapais 2013; Fletcher u. a. 2015).

Dieses Modell der menschlichen Evolution hat eine gewisse Plausibilität, aber wie lässt sich überprüfen, ob es mehr ist als eine hypothetische Option? Ein vielsprechender Ansatz geht von der allgemeinen biologischen Beobachtung aus, dass der Körper eines Tieres und sein Verhalten aufeinander abgestimmt sein müssen. Dies gilt im Prinzip für alle anatomischen und physiologischen Merkmale und das zugehörige Verhalten, von der Ernährung über die Fortbewegungsweise bis hin zu Sexualität und Brutpflege.

## Das eigenartige Phänomen der Schambehaarung

Wie schon erwähnt sind Menschen nicht völlig nackt, sondern es gibt Körperstellen, die von Haaren bedeckt sind: der Kopf und das Gesicht (bei Männern) sowie die Achseln

und die Genitalien. Warum ist dies so und welche spezielle Funktion erfüllen die Schamhaare? Zum einen fördern Scham- und Achselhaare die Verdunstung von biochemischen Signalstoffen, den Pheromonen. Diese dienen nicht nur als Sexuallockstoffe; sie haben zudem eine individuelle Note und liefern so wichtige Informationen für die Partnerwahl (Grammer u. a. 2005). Zum anderen sind Schamhaare ein Zeichen sexueller Reife. Und nicht zuletzt dienen sie als Sichtschutz. Die Genitalien vor allem der Frauen sind durch den aufrechten Gang und die Schamhaare dem Blick weitgehend entzogen. Insofern könnte dies und das Fehlen weithin sichtbarer Sexualschwellungen beim Menschen ein Indiz dafür sein, dass unsere Vorfahren in polygynen oder monogamen (single-male) Gruppen gelebt haben und nicht in multimale-multifemale Systemen.

Für diese These gibt es noch eine Reihe weiterer Indizien, von denen folgende kurz erwähnt seien:

1. In promiskuitiven Primatengruppen haben die Männchen deutlich größere Hoden als bei Paarbindung oder in Harems. Schimpansen beispielsweise haben etwa 120 g schwere Hoden bei einem Körpergewicht von rund 45 kg. Bei Menschen dagegen sind es nur rund 40 g bei einem Körpergewicht von 66 kg (Harcourt u. a. 1981). Schon aus dieser anatomischen Tatsache allein lässt sich ziemlich sicher schließen, dass Männer nicht für ein Liebesleben gemacht sind, bei dem die Frauen regelmäßig kurz nacheinander Sex mit verschiedenen Partnern haben.
2. Bei den Männchen promiskuitiver Tierarten ist der Penis mit Kratzern, Schaufeln oder Geißeln versehen, um das Sperma der Vorgänger zu entfernen (Dixson 2012, 340–358). Der menschliche Penis weist aber keine Borsten oder ähnliche Vorrichtungen auf.
3. Bei Primatenarten, bei denen die Weibchen viele Paarungspartner haben, haben sie auch signifikant mehr weiße Blutkörperchen, die für die Immunabwehr wichtig sind. Dies ist nötig, da es durch die Paarungen mit unterschiedlichen Männchen vermehrt zu Verletzungen und Infektionen kommen kann. Frauen haben nun vergleichsweise wenig weiße Blutkörperchen, was für ein single-male Paarungssystem spricht (Nunn u. a. 2000).

## Menschen und Schimpansen

Betrachtet man den Körper und das Sexualverhalten von Menschen und Schimpansen im Vergleich, dann kann man in sich stimmige Muster erkennen: Während der Körper der Schimpansen mit Fell bedeckt ist, sind die Menschen weitgehend nackt. Umgekehrt werden die Genitalien und die Signale der Fruchtbarkeit bei den Schimpansen auffällig präsentiert, während die der Menschen von Haaren bedeckt und unauffällig sind. Entsprechend stehen bei den Schimpansen beim Paarungsverhalten die Genitalien im Vordergrund, während sich beim Menschen die sehr viel selektivere Partnerwahl auf den ganzen Körper (und viele weitere Merkmale) bezieht (Short 1979; Rodseth u. a. 1991).

Die Zahl der nötigen Paarungen, bis Nachwuchs gezeugt ist, ist bei Menschen und Schimpansen zwar ähnlich hoch, doch die Zahl der Paarungspartner ist bei Schimpansen sehr viel höher (Wrangham 1993; Voland 2013, 111). Hierzu passt die Beobachtung, dass die weiblichen Schimpansen wenig sexuelle Eifersucht zeigen, Menschenfrauen dieses Gefühl aber sehr intensiv erleben. Und schließlich sei erwähnt, dass die Paarungen bei den Schimpansen weitgehend öffentlich sind, während sich Menschen in der Regel ins Private zurückziehen.

Die körperlichen Merkmale und das entsprechende Verhalten der Schimpansen sind in einem System sinnvoll, in dem die Weibchen alle Männchen zur Kopulation auffordern und das auch in aller Öffentlichkeit tun (Wrangham 1993). Die subtilen Signale der Frauen machen beim Menschen wiederum Sinn, wenn sie nur mit ausgewählten Männern im Privaten Sex haben wollen. Die Erklärung für den versteckten Eisprung der Frauen, die weibliche Eifersucht, die Unauffälligkeit der Genitalien und die Privatheit beim Sex könnte also sein, dass dadurch unerwünschte Aufmerksamkeit vermieden wird, was wiederum die Aufrechterhaltung der Paarbindung erleichtert (Junker 2016).

All diese körperlichen und Verhaltensmerkmale – von den Schamhaaren bis zum Schamgefühl, von der romantischen Liebe bis zum intensiven Sexualleben der Menschen – lassen sich so als evolutionäre Lösung eines emotionalen und sozialen Problems verstehen: Wie lassen sich Zweierbeziehungen in größeren Gemeinschaften stabilisieren, wenn es nicht möglich ist, den Partner oder die Partnerin ständig zu bewachen, da die Geschlechter bei der Nahrungssuche getrennte Wege gehen (Endicott 1999, 412–414)?

## Der Ursprung der Kleidung

Warum und wann haben Menschen mit der Kleidung ein sekundäres, künstliches Fell erfunden? Ein zweifellos wichtiger Grund war die Auswanderung aus Afrika und die Besiedelung gemäßigter und kalter Klimazonen. Klimatische Faktoren können aber nur ein Teil der Erklärung sein, denn Menschen tragen auch dann Kleidung, wenn die äußeren Bedingungen es nicht erfordern. Das Verdecken des Körpers hat offensichtlich auch eine soziale Funktion: Wenn die nackte Haut ein wichtiges Signal bei der sexuellen Partnerwahl ist, dann dient Kleidung der Entsexualisierung. Die Tatsache, dass bestimmte Kleidungsstücke die sexuelle Attraktivität wieder sekundär hervorheben, widerspricht dieser These nicht, sondern bestätigt sie.

Kleidung ist also auch ein Teil der vielfältigen kulturellen Beschränkungen und Verbote auf dem Gebiet der Sexualität, ihr Zweck ist auch das Verbergen der Genitalien. Bei Schimpansen kann man vergleichbares Verhalten in Bedrohungssituationen beobachten, die aus sexueller Konkurrenz entstehen und sich gegen die Genitalien der Rivalen richten. In solchen Situationen täuschen rangniedrige Schimpansen mangelndes sexuelles Interesse vor, um dann im Geheimen und möglichst schnell doch zu kopulieren (de Waal 1998, 162–173). Menschen bedecken ja nicht nur ihre Genitalien,

sondern sie ziehen sich auch normalerweise zur Paarung ins Private zurück.

Seit wann gibt es Bekleidungsregeln bei Menschen, seit wann gelten Nacktheit und Sex in der Öffentlichkeit als ›Erregung öffentlichen Ärgernisses‹? Ethnologische und archäologische Daten sprechen dafür, dass es schon bei Jägern und Sammlern Vorformen von Kleidung gab (Kittler u. a. 2003). Erst mit der Entstehung von Städten und Staaten in den letzten Jahrtausenden scheint es aber zu den heute anzutreffenden, weitgehenden Beschränkungen gekommen zu sein. Eine plausible Erklärung ist, dass das Zusammenleben vieler Menschen mehr sexuelle Reize mit sich bringt. Bekleidung soll in dieser Situation verhindern, dass es zu gesteigerter sexueller Aktivität außerhalb der Paarbindung kommt und dass wichtige, nichtsexuelle Tätigkeiten und Arbeiten gestört werden (Morris 1967, 80–81).

## Zusammenfassung

Zusammenfassend kann man Kleidung also als sekundäres Fell auffassen. Die Verdeckung der Genitalien wiederum lässt sich als eine kulturelle Erweiterung der Schambehaarung verstehen. Wie letztere dient die Bekleidung dem Schutz und erzeugt Unauffälligkeit; sekundär kann sie dann auch zum Ornament werden.

Wie alle kulturell überformten Merkmale variiert die Schambekleidung stark und ihre konkrete Ausformung hängt von äußeren Bedingungen wie beispielsweise der Gruppengröße ab. Nichtsdestoweniger scheinen die Schambedeckungen nicht primär gegen die Biologie gerichtet zu sein, sondern sie imitieren und verstärken ein biologisches Merkmal – die Schambehaarung. Da es bei Tieren (und damit auch beim Menschen) eine enge Beziehung zwischen körperlichen, emotionalen und Verhaltensmerkmalen gibt, würde dies entsprechend auch für das Schamgefühl gelten, das mit der Stabilisierung der Paarbindung eine wichtige biologische Funktion erfüllt. Insofern ist die Existenz des körperlichen Merkmals der Schambehaarung, die auch wie ein natürliches »Feigenblatt« wirkt, ein Hinweis auf einen biologischen, instinktiven Anteil des Schamgefühls. Das heißt, Scham wäre mehr als eine kulturelle Erfindung.

Diese allgemeinen Erwägungen lassen unberücksichtigt, dass zwischen den verschiedenen Kulturen und Zeiten tiefgreifende Unterschiede bestehen. Wie viel Nacktheit in privaten, gesellschaftlichen und künstlerischen Bereichen möglich ist und welche Bekleidungsregeln der gesamten Bevölkerung oder einem Teil – meist den Frauen – gegenüber durchgesetzt werden, ist höchst variabel. Auch hier gilt, dass die Dosis das Gift macht, was erklären könnte, dass die kulturellen Bekleidungsregeln und Schamgrenzen trotz ihrer ursprünglichen biologischen Sinnhaftigkeit von den Individuen oft als bedrückend und fremd empfunden werden – und die Rückkehr zur ursprünglichen Nacktheit befreiend wirken kann.

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# Genital cover. Dress or evolved bio-psychological impulse?

Wulf Schiefenhövel

**Zusammenfassung**

Genitalverhüllung. Bekleidung oder bio-psychologischer Impuls?

*Die Bedeckung der Genitalien ist in menschlichen Gesellschaften weit verbreitet. Ethnografische Aufzeichnungen zeigen, dass es nur in wenigen Gesellschaften den Brauch gab, völlig nackt zu sein. Für Männer scheint dies häufiger der Fall gewesen zu sein als für Frauen. In diesem Beitrag wird argumentiert, dass die Bedeckung der Genitalien unabhängig vom und historisch früher als das Anlegen von Kleidung entstanden ist und durch bio-psychisches Schamgefühl motiviert war. In einigen Gesellschaften wird der Penis durch besondere Arten der Verhüllung optisch hervorgehoben. Die Männer der Papua in vielen Stämmen des Hochlands von Neuguinea trugen Peniskalebassen, entweder lange oder runde Hüllen aus kürbisartigen Früchten. Dies wurde von den Einheimischen selbst nicht als primär sexuelle Kleidung angesehen, sondern eher als etwas, das mit männlicher Dominanz und Kriegertum zu tun hat. Nicht-menschliche Primaten stellen ihre erigierten, oft leuchtend gefärbten Penisse zur Schau als Zeichen der Bedrohung und der Bereitschaft zum Kampf. Dieser phylogenetische Hintergrund findet sich in der Funktion des Phallus als Apotropäikum wieder, auch Darstellungen der Vulva/Vagina als Sitz der ehrfurchtgebietenden weiblichen Macht können diese Funktion haben. Mit der Tendenz, seine Genitalien zu bedecken, ist das universelle Gefühl der sexuellen Scham verbunden, das die Menschen (außer in sehr seltenen Fällen) dazu bringt, Sex in der Privatsphäre und nicht in der Öffentlichkeit zu haben. Genitale und sexuelle Scham werden somit als primäre Motivation für die Bedeckung des Genitalbereichs angesehen, die sich damit von den Motivationen für das Anlegen von Kleidung stark unterscheidet.*

**Schlagwörter** Genitalscham, sexuelle Scham, Phalloi, Vulven, Neuguinea

**Summary**

*Covering the genitals is very widespread in human societies; ethnographic records show that only a few of them had the custom of being totally naked. This was, it seems, more often the case for males than for females. This contribution argues that genital cover arose independently of and historically earlier than putting on clothing and was motivated by evolved bio-psychic shame. In some societies, the penis is visually accentuated by special kinds of cover. Papuan men in a great number of highland New Guinean tribes wore penis gourds, either long or rounded sheaths, made of squash-like fruits. This was not seen by the Indigenous people themselves as a primarily sexual attire but rather as one related to male dominance and warriorhood. Non-human primates expose their erect, often brightly coloured penises as a sign of threat and being ready to fight. This phylogenetic background is present in the function of the phallus in apotropaic depictions, depictions of the vulva/vagina as the seat of awe-inspiring female power have the same function. Related to the impulse to cover one's genitals is the universal emotion of sexual shame, which guides humans (except on very rare occasions) to have sex in private and not in public. Genital and sexual shame are thus seen as the primary motivation to cover one's genital area, which would, thereby, have been very different from the motivations to put on clothing.*

**Keywords** Genital shame, sexual shame, phalloi, vulvae, New Guinea

## Introduction

The evolutionary period in which humans started to cover their genitals will probably always remain veiled in the deep history of our species. If not made from shells or other durable material, the probable ›dress‹ is unlikely to have survived. However, with the most advanced archaeological techniques, identification of clothing items (cf. Kirkinen in this volume), and even the recovery of DNA traces may be possible. Cross-cultural ethnography and bio-psychological attempts to understand the species- (perhaps genus-) typical behaviour of hiding the sexual organs from public view, guided by the concept of genital shame, remain the only promising avenues to develop testable hypotheses. In any case, the devel-

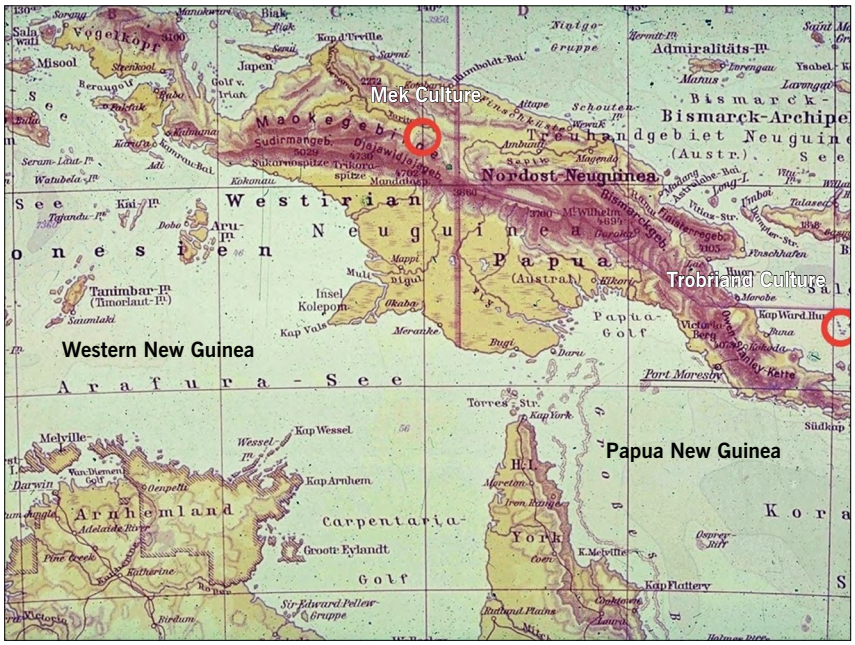


**Fig. 1** Physical map of New Guinea. The Trobriand Islands belong to Papua New Guinea. The Mek Culture is situated in the highlands of Western New Guinea, Indonesia.

***Abb. 1*** *Physische Karte von Neuguinea. Die Trobriand-Inseln gehören zu Papua-Neuguinea, die Mek-Kultur befindet sich im Hochland von West-Neuguinea, Indonesien.*

opment of genital and sexual shame remains (cf. Medicus 2025) one of the dividing lines between the animal and the human world. Another, even more striking characteristic of our species, presumably connected to the bio-psychologically embedded and monitored emotion of genital-sexual shame, is the fact that, as a rule, coitus among humans does not happen *coram publico* but in socio-sexual intimacy. The percentage of our fellow humans who engage in quasi-public sexual behaviour, e.g. in swinger clubs or during rare orgiastic events, is most probably very small. I would thus not hesitate to also class the avoidance of sex in public as a true universal (Schiefenhövel 1982; Brown 1991).

This contribution will argue that genital and sexual shame are evolved emotions that take root in our human phylogeny and develop in ontogeny. Social shame and guilt are perhaps related – but clearly different – dimensions of human psychological reactions. Interestingly, they have been studied to a much wider extent than their genito-sexual counterpart (for an overview regarding findings in bio-psychological research, see Bischof 2012). R. Benedict (1947) created the concept of »shame« cultures versus »guilt« cultures, the former being characteristic of collectivist, the latter of individualistic cultures. R. Sapolsky (2017) and others convincingly argue that Benedict's antithesis is too simple. My own work in Mainland and Island New Guinea shows that members of Papuan and Austronesian societies do indeed have strong feelings of guilt: suicide is sometimes carried out, more often by women than by men, caused by internalised guilt feelings. Furthermore, the Eipo language (Heeschen/Schiefenhövel 1983) contains various words and corresponding phrases in which the concept of guilt is clearly expressed, whereas words describing genital-sexual shame exist but seldom appear in the dictionary. Whether and how sexual shame and guilt are related is a largely unsolved issue, but it may be correct to say that social shame is, for the regulation of everyday behaviour, a more important topic than genito-sexual shame. Nevertheless, the latter is part of our bio-cultural evolution and worth exploring.

## Nakedness – Vulva and Phallus

A. von Chamisso, the great author, traveller and natural scientist, described male members of indigenous groups on some of the Caroline Islands in Micronesia as ›totally naked‹ (1836, 193). The accompanying photos prove this statement. It seems, however, that already in these early times of contact with the outside world, new ways to cover the genitals emerged: so-called ›laplap‹ (Melanesian Pidgin; German ›Lappen‹), pieces of cloth distributed by white traders and missionaries, can be seen in A. von Chamisso's and other early photographs. Men of the Asmat ethnic group on the southern coast of West-Papua (today's Indonesian Western New Guinea) kept their custom of male genital nakedness until the 1950s, as is documented in the impressive film ›Le Ciel et La Boue‹ by P. D. Gaisseau (1961). Men in some other parts of the world had the same custom, e.g. the Nuba in Africa (Riefenstahl 1976).

Public female genital nudity seems to be, in probably all or at least in the majority of societies, a much rarer phenomenon than that of male nudity, even though the penis is a much more visible organ, especially in an aroused state, than the vagina. This modesty does not apply to the female breasts, which were traditionally uncovered in very many societies, especially those living in warm climatic zones. Obviously, the breasts of women were perceived differently than the vulva/vagina and therefore did not »require« being hidden by clothes (even though – also in these societies – the breasts of girls and young women were seen as an attractive signal of sexual maturity, not only as a feeding organ). The Yanomami of the Orinoko River, Venezuela, and possibly some other ethnic groups in South America, are a partial exception regarding female genital nudity.

**Fig. 2a–b** Vulva (a) and Phallus (b) at the grand portal of Saint Stephan's Cathedral, Vienna, Austria. They protect the sacred Christian interior of the church with ancient apotropaic sexual symbolism.

***Abb. 2a–b*** *Vulva (a) und Phallus (b) am großen Portal des Stephansdoms, Wien, Österreich. Sie schützen das heilige christliche Innere der Kirche mit antiker apotropäischer Sexualsymbolik.*

Yanomami women did not wear a genital cover, but instead, a thin string around the waist. When asked whether they would take it off so it could be included in the ethnographic collection, they refused and said they would feel ashamed without it (Eibl-Eibesfeldt 1976). Thus, a symbolic sign of modesty can replace genital cover – a very interesting psycho-cognitive transposition of the genito-sexual shame impulse. Yanomami men, at least since the time their life began to be recorded, had tied the foreskin to the abdomen by means of a string around the waist and also often wore a textile loincloth, coloured red and of external origin, hanging from the belt. The men said they would feel ashamed if the string tying their penis loosened. Again, this is an indirect form of genital shame.

In traditional societies of Melanesia, like that of the Eipo (Schiefenhövel 1976) in the formerly isolated highlands of Western New Guinea, nakedness in children was considered normal. Also, what is called ›toilet training‹ in Western societies happened quite naturally as a byproduct of child care, with mothers reading signals of their infants intuitively and casually holding them to the side. Traditional customs for dealing with nudity concerned the perception of the genitals of boys versus those of girls: The genitals of girls were covered at the age of about three; they were thus much younger than their un-dressed male cohorts who received their first penis gourd at puberty (see below). This gender difference regarding the perception and covering of genitals is also present in other Papuan and Austronesian societies of Melanesia, such as the Trobrianders (Fig. 1; cf. Malinowski 1929; Schiefenhövel 1982). It is likely that this differential treatment of nakedness (and sexuality) in females versus males was once widespread, possibly global.

For the period from the late Epipalaeolithic (Natufian) to the Chalcolithic in the fertile crescent of South-west Asia, C. Beuger (2019) describes aspects of clothing and nudity in social and inter-gender aspects; she states that the overwhelming majority of depictions show naked humans. She also raises the question of whether possible ›shame and prudery of prehistoric people can be defined on the basis of archaeological and iconographical records‹ (Beuger 2019, 77). In classical antiquity, male statues were depicted entirely naked; a corresponding style of total nudity for female figures developed much later (Bonfante 1989). Public male nakedness in classical Greece is said to have been common, at least in some circles, such as in the surroundings of the ›gymnasia‹, at sports events (Sweet 1987) or academic symposia. This aspect of Greek life is often discussed (e.g. by Foucault 1976–1984) in a narrative of male ephebo-

**Fig. 3** The Upper Palaeolithic Venus figurine from Hohle Fels Cave, Alb-Donau District, Germany. Mammoth ivory.

***Abb. 3*** *Die Venusfigur vom Hohle Fels aus dem Jungpaläolithikum, Alb-Donau-Kreis, Deutschland. Mammut-Elfenbein.*

phile homosexuality between an adolescent and an adult man, the former attracted by the status, intellect and affection of the older man, and the latter by virtues like beauty, charm, innocence, and the immature physique of the teenager – pedagogic eros adding to sexual attraction. It is quite interesting that such a psycho-social setting is also found in some Melanesian cultures, in which it was customary that, during the time of their initiation, young boys had to spend a prolonged period in seclusion with older men. Frequent sexual acts were part of this form of ritualised paedophile male homosexuality (Herdt 1984; Schiefenhövel 1990).

The »Artistic Nudity« (Bonfante 1989) of the statues of the classical Greek and later Roman times present almost surreally beautiful naked male figures, and later, over time, as mentioned, equally attractive female nudes, as well. In this historical context, the gender differences in covering the genitals of girls versus boys mentioned above, as well as the general differences in covering the genitals of males and females known in many of the world's traditional cultures appear again. Another aspect is intriguing in this context: In the famous classic sculptures, athletic males are usually depicted, somewhat surprisingly, with minuscule, infantile penises. This is interpreted as a kind of counterbalance to the beauty of the bodies, which apparently should not be perceived as sexually but rather artistically attractive subjects (Bonfante 1989). In scenes painted on vases and similar objects of that time, fighting warriors are shown with the same kind of mini-penises, whereas in other technically similar paintings, male figures impress the viewer with very large erect *phalloi*. Penile erection is part of the behavioural repertoire in primate phylogeny, serving as a threat signal (first described by Ploog et al. 1963 for *Saimiri sciureus*) and, in human cultures, a powerful apotropaic sign (Fig. 2a–b; Eibl-Eibesfeldt/Sütterlin 1992); this is mimicked, e.g. by penis gourds and similar genital ›covers, in various cultures‹ (see below). The Greek artists who painted scenes of physical fights between famous, powerful heroes did not tap this evolutionary source. *Phalloi*, often in the splendour of full erection, as in the Hindu and Buddhist Tantric tradition or other societies, are embedded in a religious-sexual narrative, often, as mentioned, functioning as apotropaica. The vulva/vagina as the similarly powerful female organ is also represented in art from the Palaeolithic to our times. For example, some of the well-known early and mid-Upper Palaeolithic Eurasian ›Venus figurines‹, of which the oldest example, the Venus from Hohlefels (Fig. 3; Conard 2009; cf. Wolf/Conard in this volume), is an awe-inspiring masterpiece, seem to present the power of female sexuality. The style of these figurines contrasts with the minimalistic, schematic in-profile-representations depicting females, always with pronounced lordosis and/or steatopygia, most typical for the Late Magdalenian (Duhard 1993; Gaudzinski-Windheuser/Jöris 2015; Jöris 2021). The schematically drawn lines meaning ›woman‹ can be seen as icons, in those days and the present. Some figures (but see Jöris 2021 for the Gönnersdorf figures) may have had well-understood semiotic value as a sexual stimulant and perhaps a sign for *coitus a tergo*.

In traditional societies that linguistically belong to the Trans-New Guinea Phylum, such as the Eipo (Schiefenhövel 1982), men are awed by the powers of the vagina; they believe that vaginal secretions and especially menstrual blood are among the most harmful, poisonous fluids in the world. Only mature men who are watchful and in control of themselves can dare to have (much enjoyed) sexual intercourse with women and thus overcome the sexual antagonism between women and men. Related to this view of female sexuality as a source of enigmatic, possibly dangerous power is the concept of ›vagina dentata‹. In India, a culture-bound syndrome (Prakash/Kar 2019) warns men that they lose power by spending their sperm in a woman's vagina or by masturbation. »Purity« is thus another condition of importance for conceptualising the sexual act.

M. Douglas (1966) focussed on ›pollution‹ through food, but also through sexual intercourse. Echidna and Platypus

**Fig. 4** Babesikna, wearing a penis gourd (Eipo: *sanyum*) typical for Papuan Highlanders, and a dagger made from the tibia of a cassowary. On his shoulder, his daughter Lerwo (Eipo, Western New Guinea 1975).

***Abb. 4*** *Babesikna, der eine für die Hochlandbewohner Papuas typische Peniskalebasse (Eipo:* sanyum*) und einen Dolch aus dem Schienbein eines Kasuars trägt. Auf seiner Schulter seine Tochter Lerwo (Eipo, West-Neuguinea 1975).*

**Fig. 5** (right) Men wearing shiny convex genital covers of betelnut bark, and performing pelvic thrusts during dancing. They thereby add a sexual element to their movements (Trobriand Islands, Papua New Guinea 1983).

***Abb. 5*** *(rechts) Männer, die glänzende, nach außen gewölbte Genitalhüllen aus Betelnussrinde tragen und beim Tanzen Beckenstöße ausführen. Dadurch verleihen sie ihren Bewegungen eine sexuelle Konnotation (Trobriand Islands, Papua-Neuguinea 1983).*

still have cloacas for the two discharging channels and the reproductive one. Since then, in phylogeny, the anal channel has become separated but is still close to the openings of the urinary and sexual tracts. Interacting in very close bodily contact with this region and its marked olfactory signals and other discharges means overcoming possible reactions of avoidance and disgust. In other words, the normal sexual act requires a transformation from disgust to desire, perhaps even drawing stimulatory power from the juxtaposition and intertwinement of the two seemingly contradicting emotions. »Purity« is thus an important issue in the context of sexual shame, and some societies have rituals of cleansing after sex (Meggit 1981; Schiefenhövel 1991). G. Medicus (2025) draws attention to the fact that mothers take particular care of cleaning anal and urinary discharge, and that exactly these anatomical points, together with the mouth and ears, are erogenous zones in humans. That young boys and girls have immature, ›pure‹, non-odoriferous and non-discharging genitals may well be one reason why, deplorably, some persons prefer paedophile sex.

Objects like the Venus figurines may have been part of public life, i.e. visible to everyone or, at least, part of the group. These figurines often lack a head or face, but sometimes have an eyelet through which a string could have been fed, as in the case of the Hohlefels Venus, making it possible to wear the object as a necklace, possibly in sight of others (Conard 2009; cf. Wolf/Conard in this volume, Fig. 10). In this function, Venus figurines may represent an interesting contradiction to the claim that there is an evolved impulse, typical for our species, toward genital and sexual modesty. But art is one arena, and real life is another. A similar challenge to evolved genital shame postulated in this contribution could be seen in the custom of accentuating the penis found in several cultures. These include the suspensorium-type pad used by male ballet dancers, the prominent codpiece-like, convex cover of the genital area from the classic fighting armour employed in past centuries, and – most strikingly – the penis gourds worn by men of many societies in Highland New Guinea (Fig. 4). The latter are, however, not primarily sexual attributions, but better explained as a ›frozen erection‹ in the sense of the above-mentioned primate threat erections, i.e. a sign of male dominance in these martial cultures of male warriorhood. In Austronesian societies, like that of the Trobriand Islands, men traditionally wore shiny convex genital covers of betelnut bark (see below). During dancing, the men in both societies regularly perform pelvis thrusts, i.e. making a pantomimic phallic presentation (Fig. 5). In the context of public performance, such as these dances, cultures can and do play with otherwise strictly kept traditions and taboos. The same is true, in a more subdued form, for the dance style of Eipo women, who put on extra-large, conspicuous layers of grass skirts (*lye*, etymologically connected to the Verb *lyeb-*, to cover, to hide) which accentuate, together with vertical stripes of white chalk along their thighs and calves, the movements of the lower body (Fig. 6–7). Evolved genital shame is overcome, in these mildly sexual contexts, by the dancers' quest for impressive presentations.

## Genital and sexual shame – evolved emotions

The first visitors to the Hawaiian Islands, among them A. von Chamisso (1836), described the small genital covers worn by men and recorded its name as ›*maro*‹ or ›*malo*‹. This term is derived from *»ma«*, the proto-Austronesian etymon for shame[1]. An etymological example from a different part of the world is the old English term *scamu*, *sceomu*,

1 Austronesian Basic Vocabulary Database, <https://abvd.eva.mpg.de> (05.05.2025), cp. »malu«, ashamed, in Bahasa Indonesia and mwasila, shame, in Kilivila, the language of the Trobriand Islands, see below.

**Fig. 6** Oleto, Eipo ›prima ballerina‹ and author of a powerful love song, wearing a *lye* (grass skirt) made of *Eleocharis dulcis* stalks (Eipo, Western New Guinea 1975).

***Abb. 6*** *Oleto, die »Primaballerina« der Eipo und Autorin eines kraftvollen Liebesliedes, trägt einen* lye *(Grasrock) aus* Eleocharis dulcis *Stängeln (Eipo, West-Neuguinea 1975).*

**Fig. 7** Culturally enhanced biological dimorphism: genital cover and ways of dancing are very different in Eipo women and men (Eipo, Western New Guinea 1975).

***Abb. 7*** *Kulturell verstärkter biologischer Dimorphismus: Genitalbedeckung und Art zu tanzen sind bei Eipo-Frauen und -Männern sehr unterschiedlich (Eipo, West-Neuguinea 1975).*

which goes back to the extinct Proto-Germanic etymon **skamo,* signifying ›painful feeling of guilt or disgrace, ... shameful circumstance, ...modesty‹[2]. Obviously, there is an evolved perceptual bias, namely a specific form of shame and guilt, governing how a person presents herself/himself in public, which has led to specific linguistic expressions in the languages of the world, and which therefore represents a true universal as described in D. E. Brown's ground-breaking book (1991).

A second universal is the above-mentioned avoidance of conducting sexual intercourse in public. Humans, except on very rare occasions, do not copulate *coram publico*, but in the intimacy of an erotic encounter. The percentage of people participating in swinger parties is probably extremely small, worldwide. Of course, there are, or have been, some societies where the sexual act was less private than in most. An Inuit igloo may not offer, other than a bear skin over the loving couple, much opportunity for private intimacy. Interestingly, the Inuit also traditionally granted foreign visitors voluntary access to (not necessarily unmarried) females without the husbands or boyfriends becoming revengeful. The latter expected, however, remuneration for their generosity (Amundsen 1908). It is intriguing to question whether this was a cultural safeguard against inbreeding. By the way, incestuous relationships evoke, in many societies of the world, strong emotional disgust-like and/or aggressive reactions. As such, incest avoidance must be seen as another human universal (Westermark 1921; Bischof 1985).

A. von Chamisso (1836) was, in a remarkable deviation from his otherwise quite Christian, Victorian attitude toward these matters, enthusiastic about the possibility of indulging in free, uninhibited sex with women on the Marshall Islands. He recounted the lustiness of these encounters and mourned their loss after his departure from these ›friendly‹ islands. Additional early visitors to other Polynesian societies (e.g. Forster 1780) also reported the ›free sex‹ behaviour of local women. They liked to be the sexual partners of foreigners, from whom they expected valuable presents – especially iron objects like nails – for the favours granted. Ship captains often had to intervene and stop these remunerations lest the reserve of iron objects on the ship be depleted. The topos ›South Sea Islands = Paradise of Free Love‹ influenced many later writers as well, among them M. Mead (1928), B. Malinowski (1929), D. Marshall (1971) and others. The claims of jealousy-free love have been perpetuated in countless papers but are convincingly refuted by reliable data collected by anthropologists who spent considerable time amid these groups[3].

In Kilivila, the language on the Trobriand Islands in the Solomon Sea off the east coast of New Guinea, mwasila is the term for ›shame‹, ›embarrassment‹, and ›modesty‹ (including sexual modesty; Senft 1986). Etymologically, it is an offspring of the proto-Austronesian *ma (see above),

2 <https://etymonline.com/word/shame> (05.05.2025).

3 E.g. Schlesier 1979; Freeman 1983; Harris 1995; Schiefenhövel 2004.

likely to also be connected to mwagulu, the sea cucumber, a phallus-shaped Holothuriae (or bèche de mère in French); these marine invertebrates were and are extremely popular amongst Chinese men as aphrodisiac – no wonder, given their shape. This very much sought-after marine product, a pre-industrial Viagra, was the motor of pre-European Chinese-Pacific trade and gave rise to the Melanesian Pidgin term »bis-la-mar« in Vanuatu (Crowley 1990; Swadling 1996). The Kilivila term for husband, mwala, is also likely to be connected to mwasila; it would then express some form of shame-shaded, perhaps sexual relationship. While Trobriand society can be rather liberal regarding some sexual matters, e.g. young women enjoy much sexual freedom; on the other hand, married couples are supposed to live in strict monogamy. Nevertheless, this traditional law is, there as elsewhere, often broken. Particularly interesting is the term mwaibua (it should better be spelt mwaibuva; see below), the traditional male genital cover of the Trobriand men. It consists of a piece of the white, flexible bark of the betel palm (Areca catechu, buva in Kilivila), which is pulled between the legs and secured by a belt (Fig. 8–9). As with the Hawaiian ›maro‹/›malo‹ mentioned above, the Trobriand term for shame (probably primarily genital shame) is the same as for the particular piece of ›dress‹ covering the male genitals. The Trobriand chiefs, by the way, are the only ones who, by custom, are allowed to have more than one wife, a privilege connected to their status and position, and reserved in this matrilineal society for the members of the Malasi clan (Malinowski 1929; Weiner 1988; Schiefenhövel 2004). There is often amused laughter about the fact that the guyau (the paramount chief), especially when he is no longer in the prime of life, can hardly fulfil the sexual appetite of his 15 or more wives who, therefore, seek the company of younger men – who must always be of a different clan than the Malasi.

The Trobriand Islanders had an interesting dress code for the milamala dances (Fig. 10), which took place during the main harvest of yams (tetu, Dioscorea alata): the male dancers, usually young men, wore elaborate skirts (doba) made of banana leaf fibres, which were very similar to the ones worn by the young female dancers, whose doba were also particularly beautiful. Thus, a kind of unisex clothing – a cultural reduction of biological sex dimorphism – was required (Schiefenhövel 2004). On normal days, in contrast, the traditional male genital cover was the mwaibuva mentioned above, and the females wore plain doba. The breasts of women and girls post-puberty were uncovered.

## Hidden sexual intercourse

As stated previously, our species is unique (perhaps with the exception of chimpanzee ›consortships‹, see below) with regard to performing the actual sexual act not in public, as do our relatives in the mammalian realm, but in private. In the literature (cf. Eibl-Eibesfeldt 1989), this is often termed sexual modesty; I would like to call it sexual shame. In all the societies in Melanesia and Indonesia where I have worked in the last 59 years, coitus is a private affair. I have a report of a case where an Eipo man killed a woman who clandestinely observed him and his partner having heterosexual intercourse – as is usual for that region – in the garden, which are always private. This homicide was not, like most others, punished or revenged; public opinion apparently protected the killer. As stated before, even in our rather oversexed times, I suspect that the majority of people

**Fig. 8** Men wearing the traditional *mwaibuva* (male genital) dress while launching a *masawa* (sailing boat) for *kula* trading (Trobriand Islands, Papua New Guinea 1985).

***Abb. 8*** *Männer tragen das traditionelle* mwaibuva *(männliche Genitalbedeckung) beim Stapellauf eines* masawa *(Segelboot) für den* Kula-*Handel (Kaduwaga, Trobriand Inseln, Papua-Neuguinea 1985).*

**Fig. 9** Dance leader with traditional *mwaibuva* (male genital dress) and additional decorations, among them frangipani flowers and a thyme-like herb, both contributing attractive olfactory cues (Trobriand Islands, Papua New Guinea 1985).

***Abb. 9*** *Vortänzer mit dem traditionellen* mwaibuva *(männliches Genitalkleid) und zusätzlichen Dekorationen, darunter Frangipani-Blüten und ein thymianähnliches Kraut, die beide attraktive Geruchsreize liefern (Trobriand-Inseln, Papua-Neuguinea 1985).*

prefer privacy for the most intimate act we are capable of: a phylogenetic peculiarity that various authors have noted.

In this context, D. Morris (1967) put forward ideas that have not lost their appeal. He sees *Homo sapiens* this way: as a (1) hypersexualised animal (cf. K. Lorenz [1940] in his discussion of effects of self-domestication), (2) endowed with the largest penis among the primates, (3) with female orgasm as a new phylogenetical trait, (4) conducting sexual activity decoupled from fertile time windows, (5) concerned with relevant and important erogenous zones and their stimulation, (6) characterised by sexual imprinting (the forming of specific reactions to preferred sexual stimuli in ontogeny), and (7) engaging in frontal, face-to-face intercourse. The latter has often been ridiculed as the »missionary position« by protagonists of modern sexuality, yet there is no doubt that this position is preferred by many women (Hite 2004) and stimulates the clitoris well. Concerning female orgasm, it does, in contrast to Morris' statement, exist in other primates (Dixon 2012). In some mammalian species, ovulation is triggered by physiological changes connected to female orgasm; on the other hand, ovulation in human females – as in other species – is a chronobiologically fixed event. Orgasm is, therefore, no longer regarded as a prerequisite for conception (Jöchle 1973; Pavličev/Wagner 2016; Schiefenhövel/Trevathan 2019).

Morris goes on to discuss the possible reasons for preferring sex in private, arguing that witnessing others having intercourse in public would be too arousing for hypersexualised humans, thereby disturbing the group's social harmony and perhaps even leading to rape (Morris 1967). Not all of Morris' arguments may stand scrutiny from the point of view of modern evolutionary biology, e.g. his assertion that, through the stimulus of watching others having sex, the frequency of sexual activity will increase and result in overpopulation. This is unlikely to be considered a valid analysis. But some of his arguments for why humans have sex in private are shared by others (e.g. Eibl-Eibesfeldt 1976; Schiefenhövel 1982; Medicus 2025). The most intimate act requires privacy as an eco-psychological condition. B. Hassenstein (1982) argues that the visual aspect of human genital organs is not primarily attractive, but that they primarily have tactile appeal, so this may be one motive to hide the genitals and, more importantly, coitus itself. This probably does not accurately reflect the general perception of our genitals and intercourse: The enormous amount of sexual images, from classic art to specialised magazines and the vast domain of the internet, speak against B. Hassenstein's assumption. Romantic love, another characteristic of our species, celebrates the exquisite, unique bond, classically between woman and man, present even in preliterate societies and requiring, *per se*, intimacy between the lovers (Schiefenhövel 2009).

In the heyday of sociobiology, arguments like the ones mentioned above were discarded, as it was held that only strict individual and kin selection were valid principles in evolutionary biology. To consider that certain behaviours would bring about benefits to the group (e.g. promoting social harmony by avoiding sex in public), was ›out‹. To explain sexual intimacy, classic sociobiology therefore developed the paradigm of ›consortship‹ in chimpanzees and other primates, which made allowance for female choice (Matsumoto-Oda 1999). The leading idea is that in chimpanzee *(Pan troglodytes)* populations living in the wild, despite the basic polygynandrous structure typical for this species, the alpha male will try to reserve for himself all, or at least the majority of, copulations with presently fertile females. Therefore, he will, and actually does intervene – often brutally – when another male approaches such a highly prized, oestrus female. Some females, according to the argument, do not like this patriarchal behaviour and arrange with a male further down the hierarchy to sneak, unnoticed by the alpha, away from the group; they form what is termed a ›consortship‹ for a certain time and have sex in seclusion, unmolested by the alpha male. This, as the conclusion goes, provides the respective female a perfect chance for ›female choice‹, a principle that since the time of C. Darwin (1871) has been ranked as one of the significant evolutionary strategies. Interestingly, the Bonobos *(Pan paniscus)*, otherwise known for their lively, diversified sex life (de Waal 1995; Fruth/Hohmann 2006), especially in captivity, do not seem to have consortships. Formerly

**Fig. 10** Near unisex dress during milamala (harvest feast dance): a cultural reduction of biological dimorphism (Trobriand Islands, Papua New Guinea 1985).

***Abb. 10*** *Nahezu geschlechtsneutrale Kleidung während des Milamala-Erntefesttanzes: eine kulturelle Reduzierung des biologischen Dimorphismus (Trobriand-Inseln, Papua-Neuguinea 1985).*

carved-in-stone sociobiological views of individual and kin selection had been challenged early on, e.g. by I. Eibl-Eibesfeldt (1984) and more recently by long-time supporters of classic sociobiology, most prominently E. O. Wilson and B. Hölldobler (2005): they conceded (much to the dismay of many of their colleagues) that group selection actually is a valid evolutionary concept.

Whatever the final answer to the question of why we humans shy away from public sexual intercourse will be one day, when more ethology and experimental work in primatology has been assembled, it seems possible that all or several of the above-mentioned factors will be seen to play a more or less prominent role in bringing about one of the most striking features of our species: sexual intimacy. Most likely, preference for this behaviour is driven by an emotion or a set of emotions that might best be called sexual shame. Disregarding a few outliers, this concept unites all members of our global species and is worthy of being culturally preserved.

## Dress or genital cover?

From the above reasoning, it seems likely that humans, probably females in particular, started to cover their genitals long before clothing (in the narrow sense commonly perceived) was invented. One incentive to wear clothes is the ability to attach adornments to them (cf. M. Vanhaeren in this volume); another, probably the primary incentive, is the climate. If one no longer lives under a tropical or subtropical sun, the body needs thermal insulation. The idea that genital cover became established because of climatic factors, in the same way as clothing did, does not hold: even populations living in our planet's hot equatorial belt wear genital cover. To assume that genital cover was adapted to prevent insects and the like from crawling into the human body is quite a bizarre, non-biological argument: other animals have the same orifices but no genital cover, yet nothing bad happens.

I. Eibl-Eibesfeldt hypothesises that when today's Amerindian populations, such as the Yanomami, moved from cold Siberia to the tropical zones of South America they shed their warm clothes (1984). In the case of the Yanomami women, they kept only a symbolic piece of dress: a genital string worn around the waist, leaving the genital and anal regions uncovered. This tiny accessory fulfils, surprisingly, the embodied psychological function of genital cover and suppresses shame. If correct, this scenario of events leading to Yanomami female nakedness would provide another good example of the universality of the bio-psychological basis of genital-sexual shame: it happens in the brain, presumably as the effect of hard-wired neurological pathways in the limbic system first, and then at the genitals. The ancestors of the Yanomami would have been dressed, including genital cover, on their Trans-Beringian journey. That a symbolic genital cover survived the historic shedding of clothes shows the power of the underlying bio-psychological impulse.

## Acknowledgements

I thank my friends in Mainland and Island New Guinea for sharing their knowledge and insights with me, further thanks go to the two reviewers and Marian Vanhaeren.

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# Tooth and amber amulets – magic elements of clothing in Danish Stone Age burials

Peter Vang Petersen

**Zusammenfassung**

Zahn- und Bernsteinamulette – magische Kleidungsbestandteile in dänischen Steinzeitgräbern

*Ein Überblick über Zahnperlen und Bernsteinschmuck aus der südskandinavischen Steinzeit zeigt eine starke Kontinuität in der Verwendung von Tierzähnen und baltischem Bernstein über den gesamten Zeitraum hinweg. Obwohl Zahnperlen bis zum Ende der Bronzezeit verwendet wurden, sind deutliche Verschiebungen in der Artenzusammensetzung zu beobachten. In der frühneolithischen Trichterbecherkultur finden sich auch Bernsteinkopien von Kupferschmuck, wie spiralförmig gewickelte röhrenförmige Perlen und buckelverzierte Kupferblechscheiben mit Doppellochung.*

*Tragespuren und die Lage von Bernstein- und Zahnanhängern in Gräbern zeigen, dass diese Schmuckstücke ein Bestandteil steinzeitlicher Kleidung waren. Die hohe Anzahl von Anhängern in Gräbern mit jungen Frauen und kleinen Kindern – wie Bøgebakken 8 – spricht für ihre magische Funktion als Amulette.*

*Am Ende der mesolithischen Ertebølle-Kultur kommt es zu bedeutenden Verschiebungen, die zweifelsohne Veränderungen innerhalb der steinzeitlichen Kosmologie widerspiegeln. Im Neolithikum ist das vorherrschende Material für Anhänger und Perlen Bernstein, aber Zahnanhänger tauchen im mittleren und jüngeren Abschnitt des Neolithikums erneut wieder auf. Am Ende der Bronzezeit verschwinden Anhänger aus Tierzähnen vollständig aus den archäologischen Aufzeichnungen, während Bernstein in der Eisenzeit und im Mittelalter weiterhin ein sehr beliebtes Material für Schmuck bleibt.*

**Schlagwörter** Amulette, Steinzeitgräber, Skandinavien, Bernstein, Tierzähne

**Summary**

*A review of tooth beads and amber jewellery from the South Scandinavian Stone Age shows considerable continuity in the use of animal teeth and Baltic amber throughout the entire period. Although tooth beads were used right up to the end of the Bronze Age, significant shifts in species composition are seen. In the Early Neolithic Funnel Beaker Culture, amber copies of copper jewellery, such as spirally wound tubular beads and boss-decorated copper plate discs with double perforation, are also seen.*

*Traces of wear and the location of amber and tooth pendants in burials show that such ornaments were integrated into Stone Age clothing. The high number of pendants in graves with young women and small children like Bøgebakken 8 speak for their magical function as amulets.*

*Significant shifts, undoubtedly reflecting changes within Stone Age cosmology, occur at the end of the Mesolithic Ertebølle Culture. In the Neolithic, the dominant material for pendants and beads is amber, but tooth pendants reappear in the middle and later parts of the Neolithic. At the end of the Bronze Age, pendants made of animal teeth completely disappear from the archaeological record, whereas amber continues to be a highly popular material for jewellery throughout the Iron Age and medieval period.*

**Keywords** Amulets, Stone Age burials, Scandinavia, amber, teeth

## Introduction

Southern Scandinavia, i.e. Denmark and Scania, constitutes a unique area in a geological, natural and cultural-historical sense. The area is largely covered by glacial moraine deposits, which partly consist of stone and gravel from glacier-eroded Scandinavian mountains and partly of chalk and clay that the ice pushed up from the sea floor during the advance of the glaciers through the Baltic Sea.

In the Postglacial period, the many shallow lakes of the moraine landscape attracted settlements from all three main groups of the Scandinavian Mesolithic: the Maglemose, Kongemose and Ertebølle Cultures. As well, during the last two millennia of the hunter-gatherer Stone Age in the Atlantic period, the global sea level rise created an archipelago with countless fjords and lagoons rich in fish and other marine resources. In addition to the resident fauna, the hunter-gatherers also had the opportunity to exploit large concentrations of birds and fish passing through the region during the migratory seasons.

The mild climate and the fertility of the moraine areas formed the basis for the extensive Neolithisation that took place after the emergence of the Funnel Beaker Culture around 4000 BC (Fig. 1). Although periods of renewed focus on hunting and fishing characterise the middle neolithic groups of the Limfjord and Kattegat area, agriculture and animal husbandry remained the dominant subsistence strategies of the South Scandinavian population through-

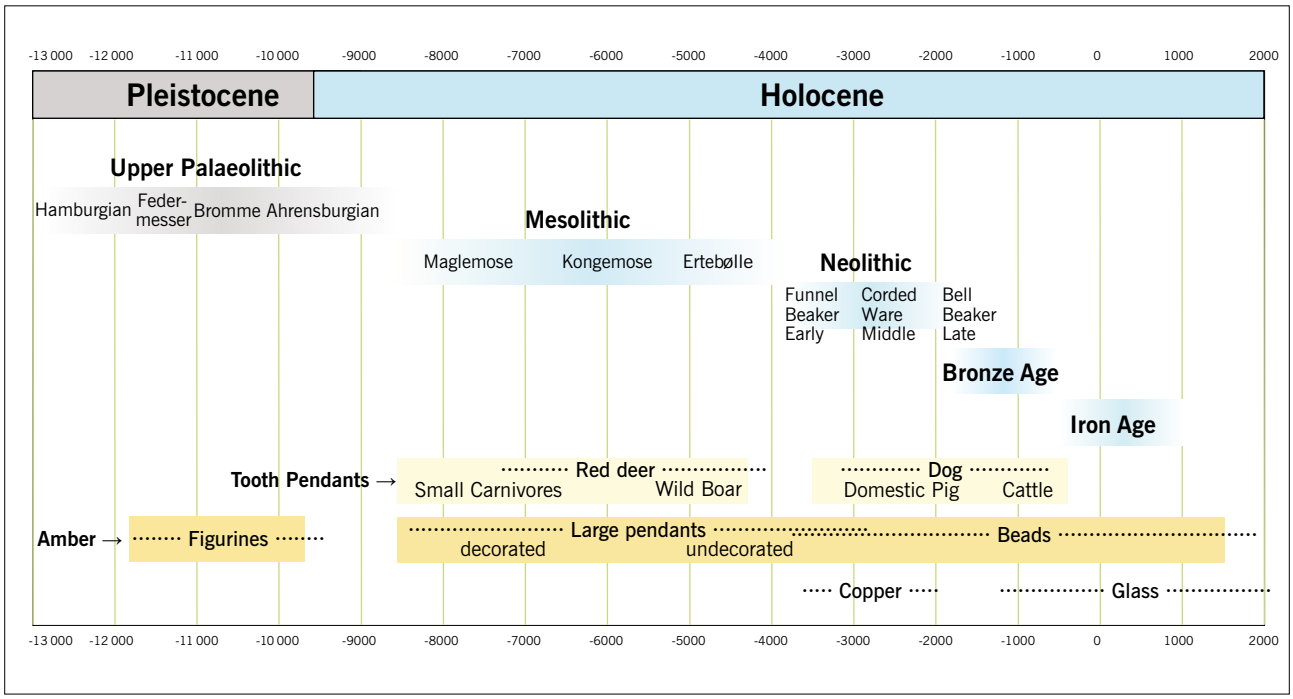


**Fig. 1** Periods, cultures and finds of jewellery/amulets in South Scandinavien prehistory between 13 000 BC and 2000 AD.

***Abb. 1*** *Perioden, Kulturen und Funde von Schmuck/Amuletten der der südskandinavischen Vorgeschichte im Zeitraum von 13 000 v. Chr. bis 2000 n. Chr.*

out the rest of prehistory. The high content of Cretaceous lime in the soil means that bones and bone artefacts are often well preserved in South Scandinavian settlement layers and graves from the Mesolithic.

High lime content also characterises the water-saturated waste layers found at many inland settlements as well as on coastal settlements along the Littorina Sea. In addition to remains of bones and teeth, a number of well-preserved amber ornaments have also been found in these water-saturated settlement waste zones, which testify to the inhabitants' great interest in Baltic amber, which can be found along most Danish coasts.

The Neolithic Funnel Beaker Culture's introduction of agriculture and animal husbandry led to a radically changed settlement pattern. The farmers moved away from the coasts to higher-lying locations where preservation conditions in the settlement layers decalcified by precipitation were poorer. However, the Neolithic population left behind many burials in monumental mounds and megalithic chambers with dry and relatively good preservation conditions for bones and amber.

Unfortunately, most Neolithic amber found in graves comes from megalithic chambers, where the preservation of amber jewellery was rarely optimal and where human bones and burial equipment are so thoroughly mixed that it is impossible to link the jewellery found to specific individuals.

On the other hand, the Neolithic population deposited a number of amber hoards in inland wetlands, where peat exca-

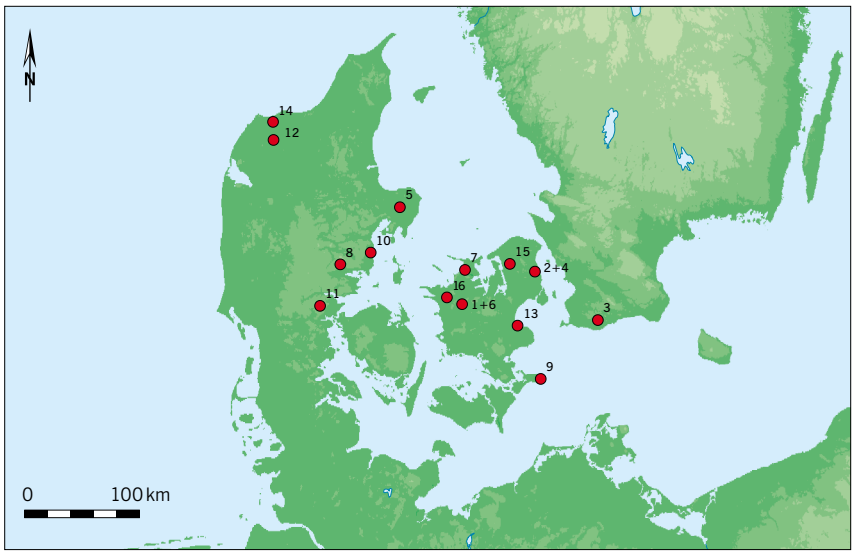


**Fig. 2** Sites mentioned in the text: 1 Åmosen; 2 Vedbæk; Bøgebakken 8; 3 Skateholm; 4 Vedbæk Gøngehusvej 7; 5 Nederst; 6 Åmosen, Studedal; 7 Dragsholm 2; 8 Årupgård; 9 Timmesø Bjerg; 10 Rude; 11 Mejsling Mose; 12 Sejerslev Mose; 13 Avlebjerg, Strøby; 14 Abildgård; 15 Græse; 16 Låddenhøj.

***Abb. 2*** *Im Text erwähnte Fundstätten: 1 Åmosen; 2 Vedbæk; Bøgebakken 8; 3 Skateholm; 4 Vedbæk Gøngehusvej 7; 5 Nederst; 6 Åmosen, Studedal; 7 Dragsholm 2; 8 Årupgård; 9 Timmesø Bjerg; 10 Rude; 11 Mejsling Mose; 12 Sejerslev Mose; 13 Avlebjerg, Strøby; 14 Abildgård; 15 Græse; 16 Låddenhøj.*

**Fig. 3a–b** Two hoards – probably amulet belts – with pendants made of perforated teeth from aurochs, elk, red deer, badger, otter, wild cat and fox have been found in Åmosen on West Zealand. The presence of perforated canines from smaller carnivores indicates a date of both hoards to the Maglemose period (Sørensen 2017, 227). a Hoard of 98 tooth pendants from Øgårde, Åmosen (T. Mathiassen 1943, 91); b hoard of 21 tooth pendants from Mosegården, Åmosen (Sørensen 2017, 227). No scale.

***Abb. 3a–b*** *In Åmosen auf Westseeland wurden zwei Horte – wahrscheinlich Amulettgürtel – mit Anhängern aus gelochten Zähnen von Auerochsen, Elch, Rothirsch, Dachs, Otter, Wildkatze und Fuchs, gefunden. Das Vorhandensein perforierter Eckzähne von kleineren Fleischfressern deutet auf eine Datierung beider Horte in die Maglemosezeit hin (Sørensen 2017, 227). a Hort von 98 Zahnanhängern aus Øgårde, Åmosen (T. Mathiassen 1943, 91); b Hort von 21 Zahnanhängern aus Mosegården, Åmosen (Sørensen 2017, 227). O. M.*

vation in historical times has brought about significant finds of excellently preserved amber jewellery (Ebbesen 1995).

Pendants of amber and animal teeth appear regularly in Danish Scandinavian Stone Age finds. Their traces of wear and the location of the ornaments in burials show that such pendants were part of people's personal dress gear.

## Tooth pendants

We do not know the reasons why Stone Age people endowed tooth pendants with magical power. The shiny whiteness, hardness, and indestructibility of the tooth enamel were probably contributing factors. Also, the behaviour of animals showing their teeth to ward off threats could have been an inspiration.

Danish finds of tooth pendants (Fig. 2) show great differences in species composition throughout the Stone Age. Teeth of small predators, which are common in Maglemose (Fig. 3), are not used as pendants in Kongemose and Ertebølle times (Sørensen 2017, 227). Dog´s teeth, which are almost absent in the Mesolithic, tend to be dominant in the Neolithic. Red deer teeth are dominant throughout the late Mesolithic, and large pendants of pig incisors and bear canines are particularly common in graves with children.

As a member of B. Petersen's excavation team at Bøgebakken near Øresund, Sjælland Region, in 1975, the present author personally experienced the close relationship between tooth pendants, women and children (Petersen 2016). On this huge multiphase Mesolithic habitation site, a series of iconic burials were excavated, the most important being burial 8, which contained a very young woman, a newborn child, red ochre, animal tooth pendants and perforated river nerite snail shells by the hundreds (Fig. 4).

On the dorsal side of the woman's pelvis lay a line of perforated red deer teeth in small bundles, along with pierced snail shells in parallel rows (Fig. 5). This arrangement of tooth pendants is probably rightly interpreted as the remains of an amulet girdle or belt resembling the amulet belts of the Netsilik Inuits (Balikci 1989, 201–202)

**Fig. 4** As a young student in 1975 the present author was entrusted with the excavation of the iconic Bøgebakken burial 8 (a young female and a new-born child [probably her son] placed on a swan's wing). This iconic find was the first Mesolithic burial in Scandinavia demonstrating the close relationship between tooth pendants, women and children.

***Abb. 4*** *Als junger Student wurde der heutige Autor 1975 mit der Ausgrabung des ikonischen Grabes Bøgebakken 8 (eine junge Frau und ein neugeborenes Kind [wahrscheinlich ihr Sohn] auf einem Schwanenflügel) betraut. Dieser ikonische Fund war die erste mesolithische Bestattung in Skandinavien, die die enge Verbindung zwischen Zahnanhängern, Frauen und Kindern zeigte.*

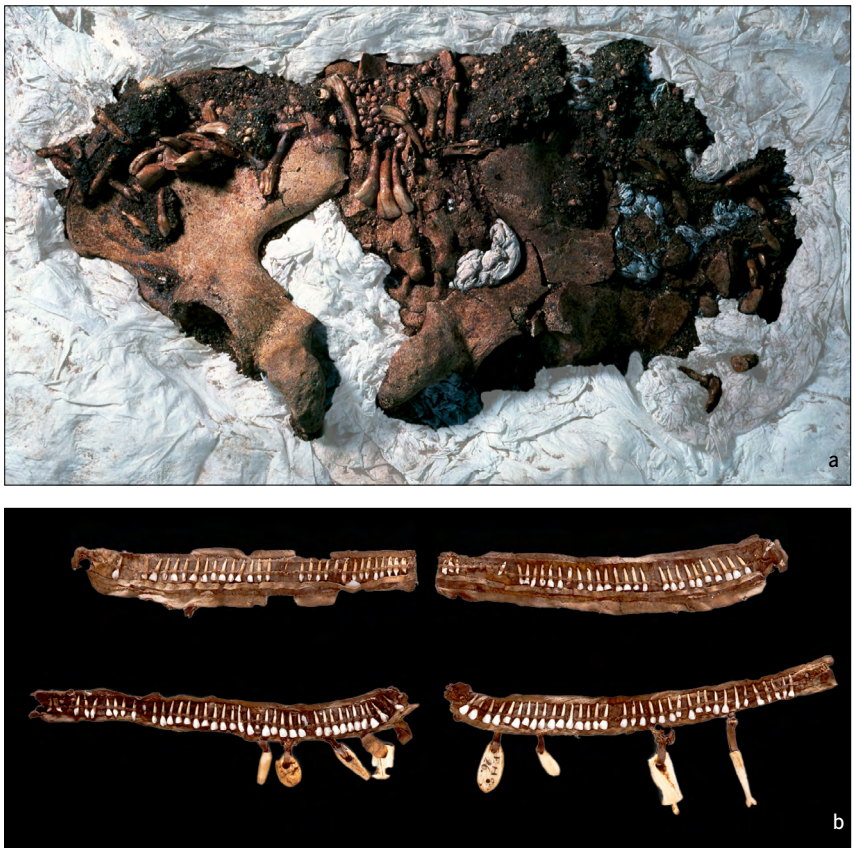


**Fig. 5a–b** a On the dorsal side of the pelvis of the woman in the Bøgebakken burial 8, a line of perforated red deer teeth in small bundles and pierced snail shells in parallel rows were found; b amulet belts from Western Greenland with 133 reindeer incisors. Brought to the King's collection (Kunstkammeret) in Copenhagen before 1690. No scale.

***Abb. 5a–b*** *a Auf der Dorsalseite des Beckens der Frau in der Bestattung Bøgebakken 8 wurde eine Reihe von durchlöcherten Hirschzähnen in kleinen Bündeln und durchbohrten Schneckenhäusern in parallelen Reihen gefunden; b Amulettgürtel aus Westgrönland mit 133 Rentierschneidezähnen. Diese wurden vor 1690 in die Sammlung des Königs (Kunstkammeret) in Kopenhagen gebracht. O. M.*

and the Inuit amulet belts that entered the King's collection (Kunstkammeret) in Copenhagen in the 17th century (Fig. 5b; Petersen 2016, 113 Fig. 3). Similar waist belts with red deer teeth are found in women's graves at Dragsholm on Northwest Zealand and at Skateholm, in southern Scania, Sweden.

Next to the head of the Bøgebakken woman, there was a dense concentration of pendants with a similar combination of deer teeth and snail shells. But in this concentration, there were also larger pendants made from wild pig´s teeth (Fig. 6); such larger tooth pendants are not seen in the aforementioned amulet belts associated with young adult women but have instead been found repeatedly in burials with small children.

In most publications of the Bøgebakken finds (Albrethsen/Petersen 1977; Petersen 2015) this concentration of ornaments close to the head was interpreted as the belt decoration on one or several extra garments, placed as a pillow under the woman's head. Since then, this interpretation has been questioned (Petersen 2016). No pendants were found under the woman's head, and the concentration contains a higher number of teeth compared to any known amulet belts. To a greater extent, the concentration of pendants at the head of the woman in Bøgebakken burial 8

**Fig. 6** Next to the head of the woman in Bøgebakken 8, there was a dense concentration of deer teeth pendants and perforated snail shells. The concentration also contained larger pendants made of wild boar incisors.

***Abb. 6*** *Neben dem Kopf der Frau in Bøgebakken 8 befand sich eine dichte Konzentration von Hirschzahnanhängern und durchlöcherten Schneckenhäusern. Die Konzentration enthielt auch größere Anhänger aus Wildschweinschneidezähnen.*

**Fig. 7a–c** Compared to the combination of different incisors attached to the girdle/belt of the Bøgebakken 8 woman (b), the concentration of pendants near the woman's head (a) consists to a greater extent of small lateral incisors compared to larger central incisors; c the perforated snail shells and animal incisors from Bøgebakken burial 8 probably served as protective amulets placed on the young woman's girdle belt and on a decomposed carrying bag (papoose) for her baby. No scale.

***Abb. 7a–c*** *Vergleich der Kombination verschiedener Schneidezähne, die am Gürtel der Frau von Bøgebakken 8 befestigt waren (b). Die Konzentration von Anhängern in der Nähe des Kopfes der Frau (a) besteht zu einem größeren Teil aus kleinen lateralen Schneidezähnen, verglichen mit größeren zentralen Schneidezähnen; die durchlöcherten Schneckenhäuser und Tierschneidezähne aus der Bestattung Bøgebakken 8 dienten wahrscheinlich als Schutzamulette, die am Gürtel der jungen Frau und an einer zersetzten Tragetasche (Papoose) für ihr Neugeborenes angebracht waren (c). O. M.*

consists of smaller lateral incisors in comparison to larger central incisors (Fig. 7a). The snails are not mixed with the teeth but lie in a separate concentration.

Therefore, the present author has suggested that the pendants at the woman's head in Bøgebakken burial 8 constitute the decoration of a papoose (a carrying bag) for the baby (cf. Fig. 7c) – an extremely important form of dress equipment that we can only expect to encounter where women were buried with infants – as for example Bøgebakken 8 and the ›female shaman‹s' grave at Bad Dürrenberg, Saalekreis District, Germany (Petersen 2016, 122 Fig. 18). Another possible scenario is that dead infants occasionally might have been buried unaccompanied in the amulet-decorated papoose (i.e. a bag for child carrying ; cf. Friederich et al. in this volume) in which the living child was otherwise intended to be transported as for example the infant burials at Wilczyce, Lower Silesian Voivodeship, Poland (Irish et al. 2008), Arma Veirana (Hodgkins et al. 2022), and Vlasac H297, Danube Gorges, Serbia (Cristiani/Boric 2012).

Pendants and beads used as a protective decoration on papooses are known from cultures spread all over the globe, and the usefulness of a carrying bag in all kinds of climates makes it likely that we are dealing with women's oldest type of equipment. The use of the papoose probably goes back many hundred thousand years in human history.

At Skateholm in Scania, a burial was found where a 30-year-old female was placed in a seated position with a newborn child in her arms. The baby is covered with approx. 30 large pendants of wild pig's teeth – perhaps attached to a papoose (Petersen 2016, 120 Fig. 14)?

A grave at Gøngehusvej 7 in Vedbæk, Northeast Zealand, contained an approx. 3-year-old child and an adult, a approx. 40-year-old woman. A few dental pendants were found at the woman's head and chest. The child had a larger collection lying in a lump on his chest – mainly pig incisors, but also a perforated stone. Toe bones from a roe deer lying on the woman's chest have inspired B. Petersen to suggest that the woman was wrapped in a roe deer skin. Another possibility is that the deer skin formed a sling that the woman had used to carry the child and to which the amulet pendants were attached (Petersen 2016, 120)

Mesolithic burials of unaccompanied children are few in Denmark. In the burial of a 5-year-old child from the Ertebølle site of Nederst, Northeast Jutland, a 17 cm long knife blade indicates the child's male gender. On the child's chest were placed a cluster of six perforated wild pig's incisors as well as a single aurochs' tooth. Between the legs, a cluster of red deer incisors was found (Fig. 8).

## Amber ornaments

Most Mesolithic amber ornaments are finds without context. However, there are a handful of settlement-dated pieces that permit a chronological division of the material, placing the ornamented pieces as generally older than the unornamented ones, and where figurative pieces of animal shape seem to belong exclusively to the Late Palaeolithic (Petersen 2021).

Amber jewellery appears rarely in Mesolithic graves. An exception is grave 41 at Skateholm, which contained the remains of a 60-year-old man and a 4-year-old child. On the child's chest lay a cluster of amulets: two perforated bear teeth and four undecorated amber pendants (Larsson 1988; Petersen 2016, 121 Fig. 15).

Mesolithic amber pendants often bear signs of long-term use. Traces of wear and broken suspension holes are

**Fig. 8** This ochre grave with a child (probably a boy), c. 5 years old, was found at Nederst in Djursland, eastern Jutland. He had been given a magnificent 17 cm-long flint knife and several tooth beads from red deer, boar and aurochs. On the child's chest was a cluster of six perforated pig's teeth and one aurochs tooth. Between the legs was a cluster of red deer teeth.

***Abb. 8*** *Dieses ockergefärbte Grab mit einem Kind (wahrscheinlich ein Junge), ca. 5 Jahre alt, wurde bei Nederst in Djursland, Ostjütland, gefunden. Man hatte ihm ein prächtiges, 17 cm langes Feuersteinmesser und mehrere Zahnperlen von Rothirsch, Wildschwein und Auerochse mitgegeben. Auf der Brust des Kindes befand sich ein Bündel von sechs durchbohrten Schweinezähnen und ein Auerochsenzahn. Zwischen den Beinen befand sich eine Ansammlung von Rothirschzähnen.*

not removed. On the contrary – signs of advanced age seem to strengthen the amuletic value of the pieces (Fig. 9).

With the advent of the Funnel Beaker Culture, a profound shift takes place in the use of tooth and amber, the most important amulet materials. Unfortunately, only a very few Neolithic burials in Denmark have good conditions for amber and skeletal remains, and therefore only a little is known with respect to the placement of the amber ornaments.

One of the most interesting finds was made in 1973 when Brinch Petersen was excavating at Dragsholm. Earlier the same year a Mesolithic grave had been found containing two women – according to aDNA, mother and daughter (Allentoft et al. 2024, 331) – sprinkled with red ochre and provided with rows of red deer tooth pendants, suspended in lines – probably originally belonging to amulet belts worn around the hips (Price et al. 2007, 194).

In order to find additional Mesolithic ochre graves, trenches were dug over the adjacent area. No more ochre graves were found, but instead, a small oval depression (burial 2) was discovered, containing the skeleton of a young Neolithic warrior (Fig. 10; Price et al. 2007, 194). This man's grave from Dragsholm is dated to the early Funnel Beaker Culture (cf. Fig. 1) and, as such, is one of the earliest Neolithic burials found in southern Scandinavia. In the grave, elongated ellipsoid pendants were placed on the man's chest and upper arms. Smaller cylindrical beads for serial stringing on a cord were not seen.

## Copper ornaments

Animal tooth pendants are absent in the Funnel Beaker Culture. Instead, amber ornaments appear in many different shapes, some of which clearly mimic continental copper jewellery types like boss- ornamented discs and spiral cylinders. The hoard find from Årupgård in East Jutland contained a Neolithic lugged vase stuffed with amber as well as copper ornaments (Sylvest/Sylvest 1960). The hoard clearly demonstrates how copper-wire spirals were imitated in amber as long tubular beads (Fig. 11).

A characteristic Early Neolithic copper ornament type is the perforated and boss-decorated disk made of copper

**Fig. 9** Mesolithic amber pendants like this piece from Studedal in Åmosen, West Zealand, often bear signs of long-term use. Signs of advanced age apparently strengthened the amuletic value.

***Abb. 9*** *Mesolithische Bernsteinanhänger wie dieses Stück aus Studedal in Åmosen, Westseeland, tragen oft Spuren eines langjährigen Gebrauchs. Anzeichen von höherem Alter verstärkten offenbar den Stellenwert des Amuletts.*

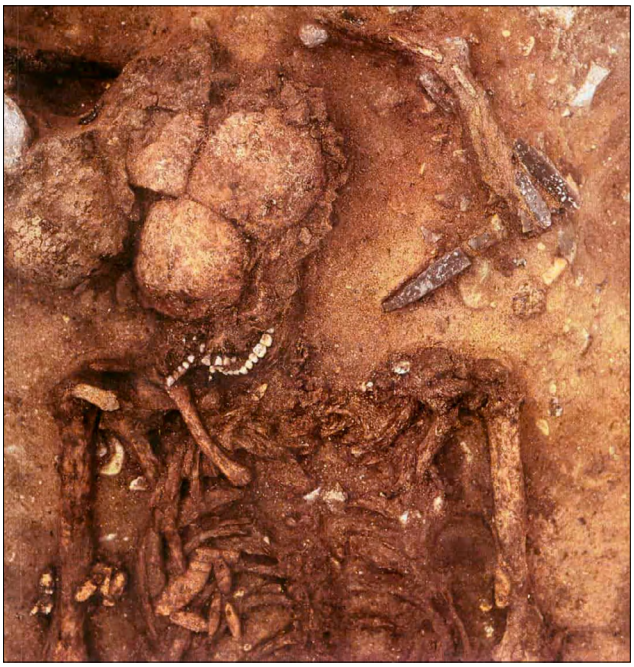

**Fig. 10** In the Early Neolithic Dragsholm II grave, elongated ellipsoid pendants were placed on the man's chest and upper arms.

***Abb. 10*** *Im frühneolithischen Grab Dragsholm II wurden längliche ellipsenförmige Anhänger auf der Brust und den Oberarmen des Mannes angebracht.*

plate (Fig. 12a–b). This type of copper ornament has been found in a few Early Neolithic burials in Denmark. Such copper ornaments were also imitated in amber as so-called ›*ravsole*‹ (amber suns; cf. Fig. 12c; Glob 1952, 23; 88 No. 125; Ebbesen 1995, Type K,34). The two central perforations of the circular copper plates and amber disks correspond to the double perforations seen on several early Neolithic bone wrist guards (cf. Fig. 12d; Becker 1960). The discovery of a skeleton in a long-barrow burial at Rude south of Århus in East Jutland, which had a copper disk tied to the left forearm with copper wire (Madsen 1979, 80), suggests that such copper disks, and also their imitations in amber, probably functioned as wrist guards; which were worn as a status-marking accessory by bowmen throughout the Neolithic.

In the Late Neolithic Bell Beaker Culture, wrist guards were normally made of slate, but in earlier parts of the Danish Neolithic the wrist guards were apparently made from various kinds of valuable, magical material, such as bone/antler, copper and amber.

## Revival of tooth pendants

After several hundred years of absence, tooth pendants reappear in the middle part of the Funnel Beaker period. Now, neither red deer nor other wild species provide teeth for the Neolithic pendants, but domesticated dogs and pigs instead. A selection of dog teeth pendants and amber beads (Fig. 13) comes from a hoard in a peat bog at Sejerslev, Northwest Jutland (Ebbesen 1995, 67).

**Fig. 11** This Early Neolithic hoard of amber and copper ornaments stored in a lugged vase was found at Årupgård, Central Denmark Region. The long tubular amber beads probably mimic spiral cylinders of copper like the ones which are also present in the hoard (below).

***Abb. 11*** *Dieser frühneolithische Depotfund aus Bernstein- und Kupferschmuck wurde in einem Ösengefäß verwahrt in Årupgård, Region Midtjylland, Dänemark, gefunden. Die langen röhrenförmigen Bernsteinperlen ahmen wahrscheinlich spiralförmige Kupferzylinder nach, wie sie auch im Hort (unten) zu finden sind.*

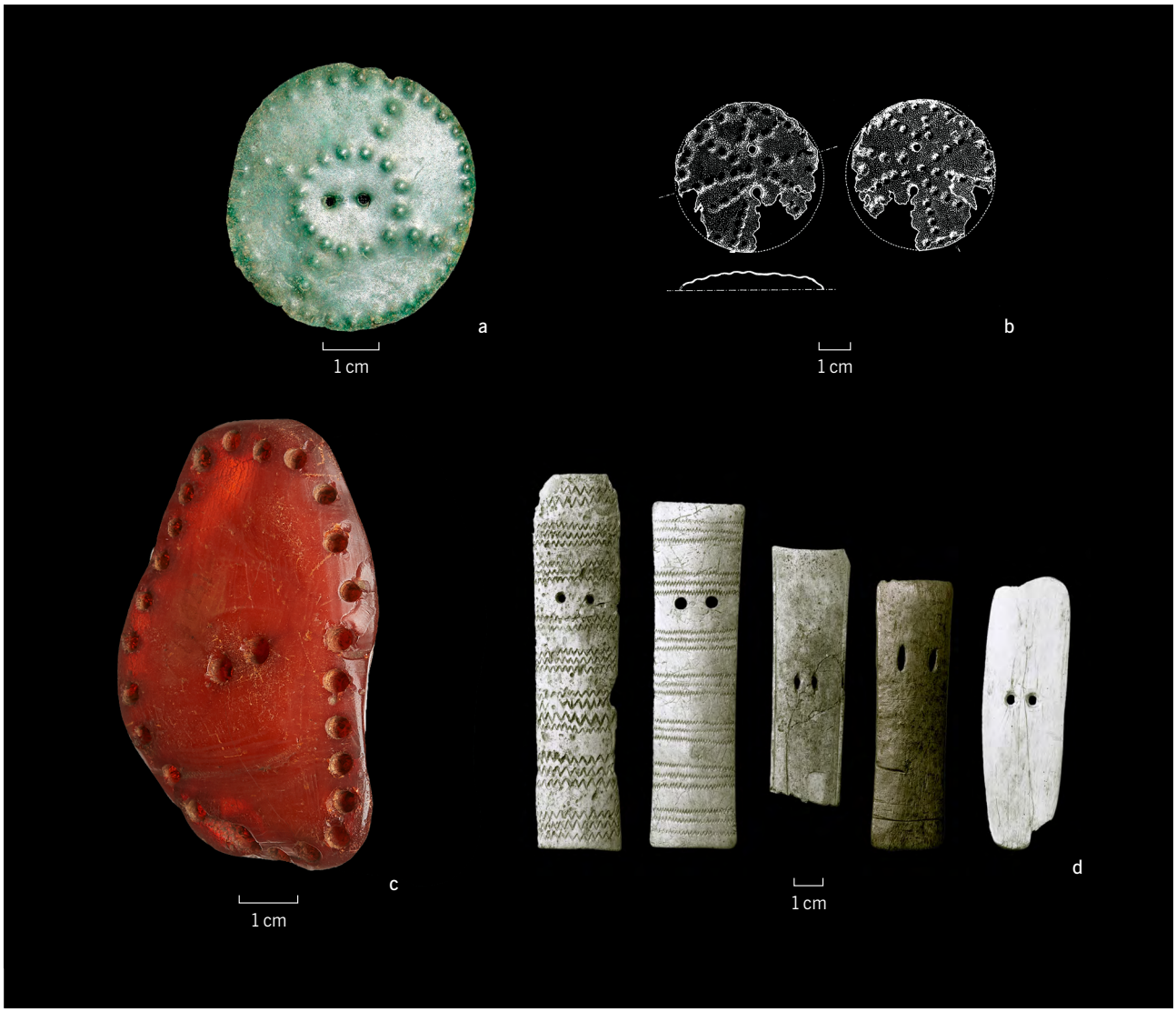


**Fig. 12a–d** a Double perforated, boss-decorated disc of copper from Timmesø Bjerg on Møn, Zealand; b double perforated, boss-decorated disc of copper from Rude, East Jutland; c double perforated, drill-hole-decorated plate of amber (a wristguard?) from Mejsling Mose, East Jutland; d double perforated, Early Neolithic wrist guards of bone from different locations in Southeast Jutland and Western Zealand.

***Abb. 12a–d*** *a Doppelt gelochte, buckelverzierte Kupferscheibe aus Timmesø Bjerg auf Møn, Seeland; b doppelt gelochte, buckelverzierte Kupferscheibe aus Rude, Ostjütland; c doppelt gelochte, mit Bohrlöchern verzierte Platte aus Bernstein (ein Armschutz?) aus Mejsling Mose, Ostjütland; d doppelt gelochte, frühneolithische Handgelenkschützer aus Knochen von verschiedenen Fundorten in Südostjütland und Westseeland.*

In the Middle Neolithic, amber beads are often found as grave goods, but the state of preservation in the megalithic tombs is usually rather poor (Ebbesen 1995, 35). Due to disturbances from later burials, it is unclear how the age and gender of the deceased affected the distribution of different amulet types.

Unlike Mesolithic amber jewellery, which often acquired additional protective power through incised ornamentation (Petersen 2021), Neolithic amber jewellery is unornamented. On the other hand, the pieces are often carefully shaped as symbolic weapons. Double-edged stone axes and flat axe blades of copper seem to have inspired such amber copies (Fig. 14).

The spread of later-immigrating Neolithic groups, such as the coastal Pitted Ware Culture around the Kattegat/Limfjord area and the pastoral Corded Ware/Single Grave Culture in Jutland, influenced the development of a local East Danish Corded Ware Culture (Danish: Enkeltgravs-kultur; German: Einzelgrabkultur); within this group and in the succeeding Late Neolithic Dolktid (›dagger‹) period, jewellery made of animal teeth and bird bones reappears in the burials (Becker 1950).

An example of the Middle Neolithic renaissance of ›Mesolithic‹ pendants is a burial found in a small cemetery containing stone-packed graves at Avlebjerg on Stevns, East Zealand (Fig. 15a; Becker 1950, 203–207). One of the graves contained two children (cf. Fig. 15b), one of whom was richly adorned on the chest and pelvis with tubular bird-bone beads and pendants of pig's incisors (cf. Fig. 15c). At the child's chest, a pair of small amber beads and three lunular pieces of split pig´s tusks with perforations for suspension were found (Fig. 15d). Other lunular-shaped tusk ornaments are known from the Neolithic in Denmark. Mesolithic parallels to the tusk ornaments from Bad Dürren-

**Fig. 13** Middle Neolithic hoard of perforated dog canines and amber beads from Sejerslev Mose in North Jutland. No scale.

***Abb. 13*** *Mittelneolithischer Depotfund von durchbohrten Hundezähnen und Bernsteinperlen aus Sejerslev Mose in Nordjütland. O. M.*

**Fig. 14** Amber ornaments from the Låddenhøj passage grave in Western Zealand. Neolithic amber jewellery is rarely ornamented. Several types are shaped like symbolic weapons. Such amber copies seem to have been inspired by double-edged battle axes of stone and flat axe blades of copper. No scale.

***Abb. 14*** *Bernsteinschmuck aus dem Ganggrab von Låddenhøj in Westseeland. Neolithischer Bernsteinschmuck ist selten verziert. Mehrere Arten sind wie symbolische Waffen geformt. Solche Bernsteinexemplare scheinen von zweischneidigen Streitäxten aus Stein und flachen Axtklingen aus Kupfer inspiriert worden zu sein. O. M.*

berg (Orschiedt et al. 2023; Petersen 2016, 122 Fig. 18) have not been found in Denmark.

The child from Avlebjerg has been $^{14}$C-dated to the early part of the Middle Neolithic. Its DNA was analysed within a large aDNA project carried out recently on Swedish and Danish Stone Age skeletons (Allentoft et al 2024). The analysis shows that the child from Avlebjerg had suffered from the plague (Seersholm et al. 2024, 2). Could the child's suffering from this deadly disease be the reason for the unusually rich assemblage of tooth and amber pendants?

Another remarkable example of a presumed Neolithic child's burial is a small stone cist (approx. 1,4 m long and 1,25 m wide) found in 2013 at Abildgård in Thy, Northwest Jutland (Fig. 16a–b; Bech 2014). The grave has an unusually high quantity of amber jewellery: eleven intermediary pieces, type h2 (after Ebbesen 1995, 34), approx. 40 smaller disk-shaped beads, and two tubular beads. Unfortunately, all traces of bones or teeth of the buried person were dissolved in the acidic soil. The many intermediary pieces of amber suggest an originally complicated jewellery composition with parallel chains of perishable beads such as animal teeth, bird bones, snail shells or seashells.

The distribution of intermediary pieces in the grave could indeed reflect the existence of a papoose (see also Friederich et al. in this publication), but in general, we have no concrete evidence for such baby-carrying equipment in the Danish Neolithic.

In the Late Neolithic Dagger period, rich assemblages of beads made from bird bone tubes, shell discs and perforated dog teeth are seen in some female burials (Fig. 17a–d; Kjær 1910; Ebbesen 2007, 37).

The use of amber continues unabated throughout the rest of Danish prehistory. Tooth pendants, on the other hand, seem to disappear in the late Bronze Age. The youngest Danish finds are pendants made of teeth from dog and domestic cow, which lay together with the cremated bones of a child in a face urn from the Late Bronze Age in Thy, Northwest Jutland (Mikkelsen 2000).

## Conclusion

A review of Mesolithic and Neolithic tooth beads and amber jewellery from the South Scandinavian Stone Age

**Fig. 15a–d** Two stone coffins with well-preserved skeletons of children were found in 1937–1939 at Avlebjerg, near Strøby on Stevns, Eastern Zealand. One coffin contained a child with no ornaments (a). The second coffin or cist contained the remains of two children (b), one of whom was richly adorned with tubular bird-bone beads and pendants of pig's incisors (c). A pair of small amber beads was also found, along with three perforated lunular pieces of split pig´s tusks (d). This burial has been $^{14}$C-dated to the Middle Neolithic: the aDNA analysis shows that this child suffered from the plague (Seersholm et al. 2024).

***Abb. 15a–d*** *Zwei Steinsärge mit gut erhaltenen Kinderskeletten wurden 1937–1939 in Avlebjerg, in der Nähe von Strøby auf Stevns, Ostseeland, gefunden. Ein Sarg enthielt ein Kind ohne Schmuckbeigaben (a). Der zweite Sarg oder die Kiste enthielt die Überreste von zwei Kindern (b), von denen eines reich mit röhrenförmigen Perlen aus Vogelknochen und Anhängern aus Schweineschneidezähnen geschmückt war (c). Außerdem fand man ein Paar kleine Bernsteinperlen und drei durchlöcherte lunare Stücke aus gespaltenen Schweinsstoßzähnen (d). Diese Bestattung wurde mit $^{14}$C auf das Mittelneolithikum datiert: Die aDNA-Analyse zeigt, dass dieses Kind an der Pest litt (Seersholm et al. 2024).*

shows considerable continuity in the use of animal teeth and Baltic amber throughout the entire period. Although tooth beads are used right up to the end of the Bronze Age, significant shifts in species composition are seen from the Mesolithic, when only teeth of wild species – especially red deer – are used, until the Neolithic, when mainly

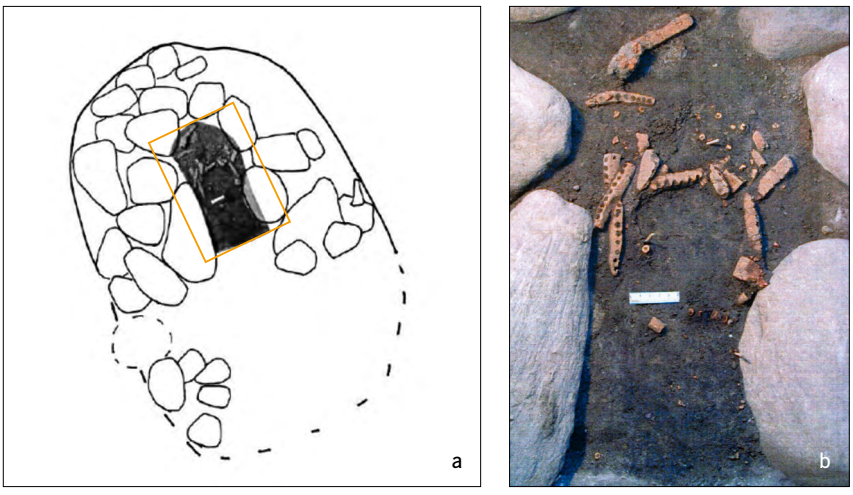


**Fig. 16a–b** a Presumed child burial from the Middle Neolithic period was found in a small stone coffin at Abildgård in Thy, North Jutland. b The grave has an unusually high quantity of amber jewellery: 11 intermediary pieces, approx. 40 smaller disk-shaped ornaments and two tubular beads.

***Abb. 16a–b*** *a Eine mutmaßliche Kinderbestattung aus dem Mittelneolithikum wurde in einem kleinen Steinsarg in Abildgård in Thy, Nordjütland, gefunden. b Das Grab weist eine ungewöhnlich große Menge an Bernsteinschmuck auf: 11 Zwischenstücke, ca. 40 kleinere scheibenförmige Ornamente und zwei röhrenförmige Perlen.*

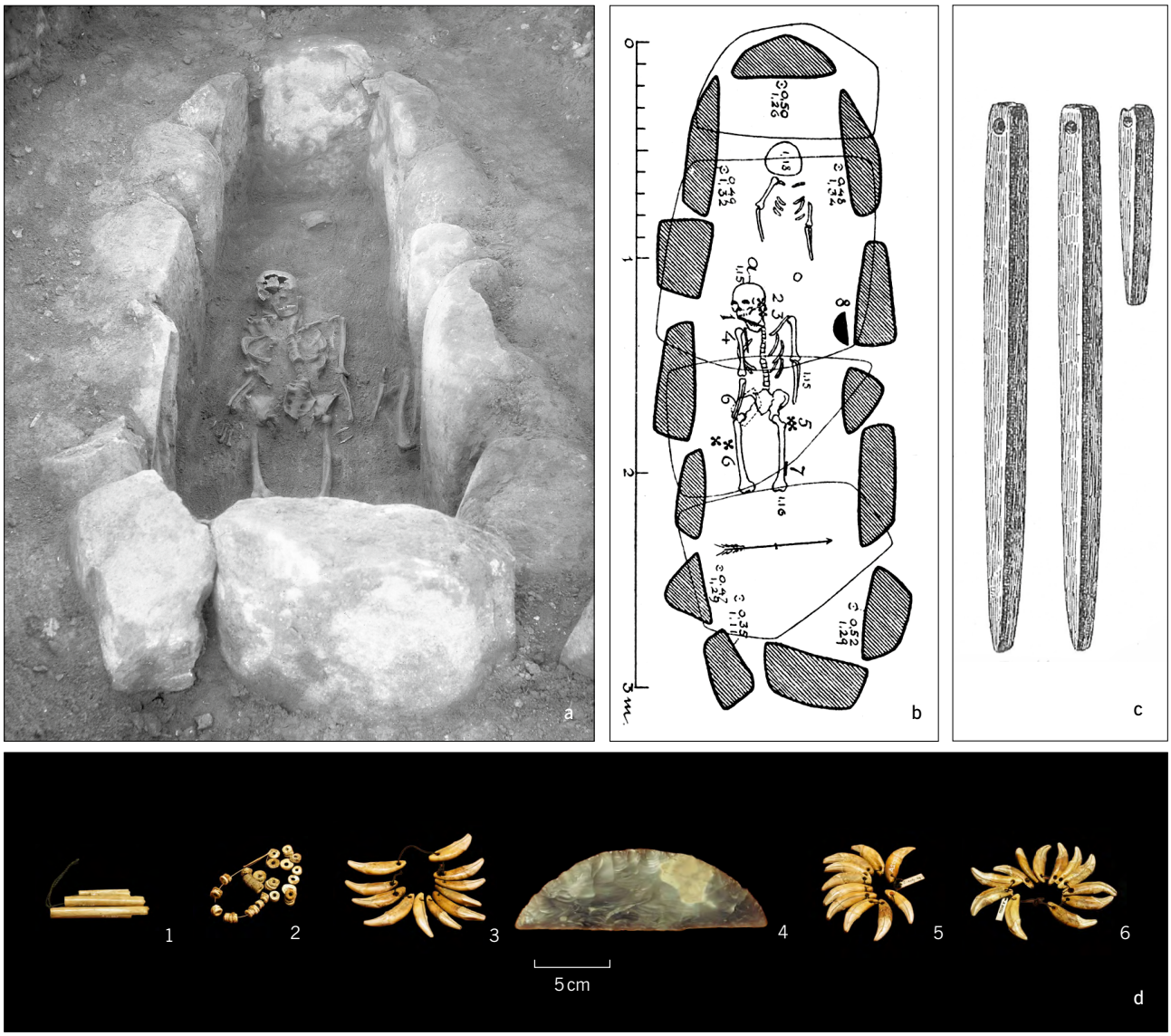


**Fig. 17a–d** The excavation of a Late Neolithic (Dagger period) stone cist at Græse in Northeastern Zealand revealed an undisturbed female skeleton situated on top of dispersed human bones from several earlier burials (a). The woman (b) was equipped with an unusual rich assemblage of ornaments: 3 slate pendants (c), 33 perforated dog canines (d3.5–6), 3 bird-bone tubes (d1) and numerous flat disc shaped beads made of shell from freshwater mussel (d2). A lunular, flat trimmed flint sickle (d4) found beside the skeleton might belong to an older burial.

***Abb. 17a–d*** *Bei der Ausgrabung einer spätneolithischen (Dolchzeit) Steinkiste in Græse im Nordosten Seelands wurde ein intaktes weibliches Skelett gefunden, das auf verstreuten menschlichen Knochen aus mehreren früheren Bestattungen lag (a). Die Frau (b) war mit einer ungewöhnlich reichhaltigen Sammlung von Schmuckstücken ausgestattet: 3 Schieferanhänger (c), 33 durchbohrte Hundezähne (d3.5–6), 3 Röhren aus Vogelknochen (d1) und zahlreiche flache, scheibenförmige Perlen aus Süßwassermuschelschalen (d2). Eine neben dem Skelett gefundene lunulare, flach geschliffene Feuersteinsichel (d4) könnte zu einer älteren Bestattung gehören.*

dogs and domestic pigs supply teeth for jewellery. Amber appears in the Mesolithic mainly as larger pendants made of smoothly scraped lumps without much further shaping. Additional decoration with incised or drilled ornamentation particularly characterises the early Mesolithic phases, i.e. the Maglemose Culture and the Kongemose Culture. More intensively cut, flat, sack-shaped and undecorated pendants appear especially in the late Ertebølle Culture and in Neolithic times. Smaller amber beads for stringing in rows on cords seem to be a Neolithic phenomenon. In the early Neolithic Funnel Beaker Culture, amber copies of copper jewellery are also seen, such as spiral-wound tubular beads and boss-decorated plate discs with double perforations. The latter type is interpreted, based on a grave find from Rude, as part of an archer's wrist guard, in line with the bone wrist guards that appear in several Early Neolithic male graves.

Traces of wear and the location of amber and tooth pendants in burials show that such ornaments were often integrated into Stone Age clothing. The high number of pendants in graves with young women and small children speaks to their magical function as amulets to ward off evil. The ornaments were probably not intended to signal social status, and children with many pendants were not necessarily ›princes‹ but perhaps, rather, hopelessly ill kids. Significant shifts, undoubtedly reflecting changes within Stone Age cosmology, occur at the end of the Mesolithic Ertebølle Culture. In the Neolithic, the dominant material for pen-

dants and beads was amber, but tooth pendants reappeared in the middle and later parts of the period. At the end of the Bronze Age, tooth pendants completely disappear from the archaeological record. Throughout the Iron Age and medieval periods, amber continues to be a highly prized material, even though coloured glass is gradually taking over as the preferred bead material in Scandinavian Bronze and Iron Age societies.

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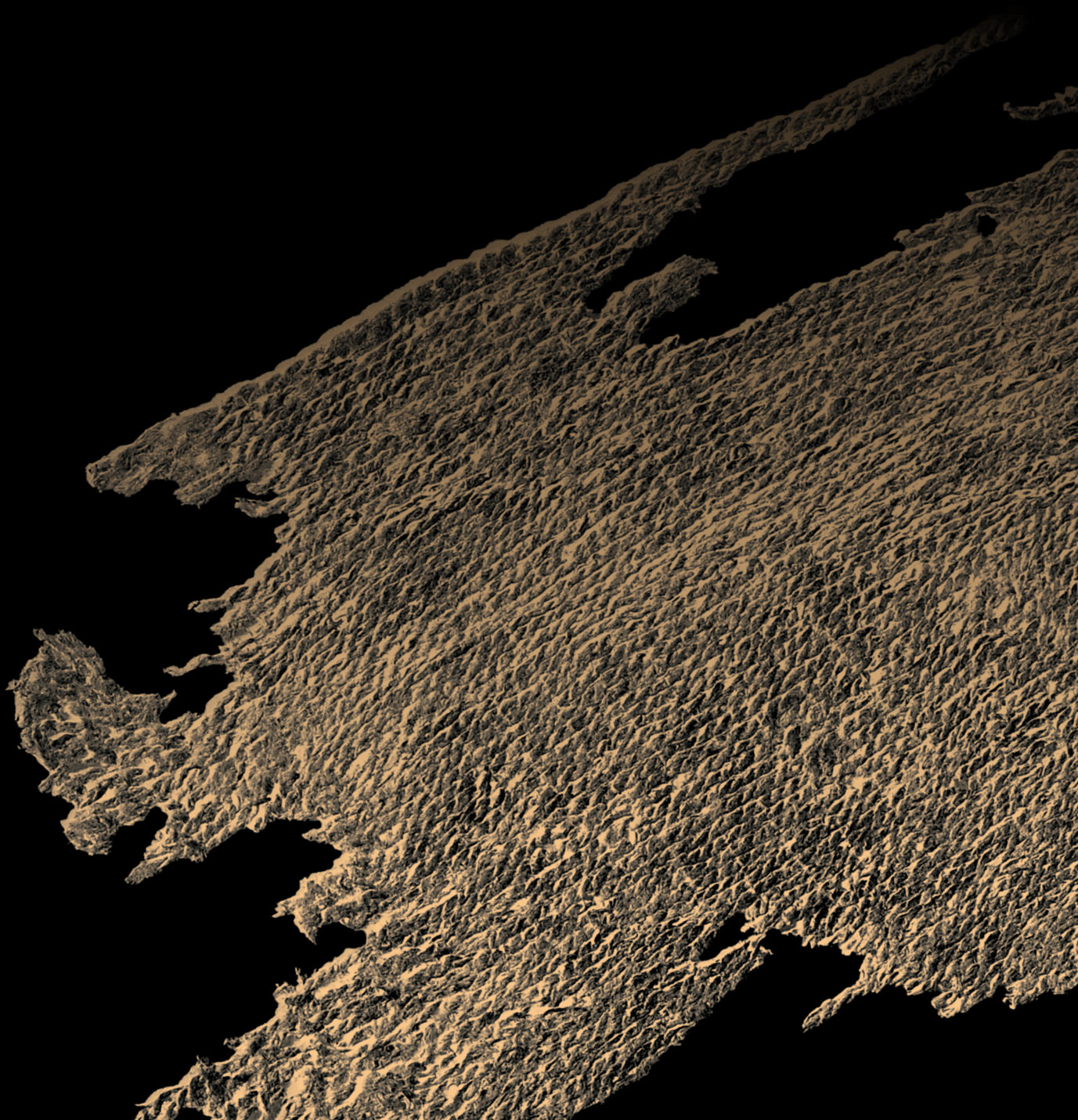
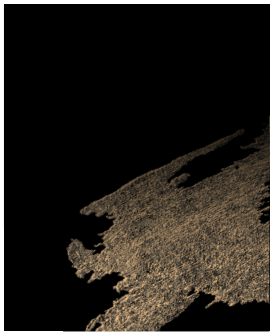
# SEKTION IV: MATERIALIEN UND METHODEN ZUR HERSTELLUNG VON KLEIDUNG

# SECTION IV: MATERIALS AND METHODS IN CLOTHING PRODUCTION





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*This cloth was made of tree bast and line and was found in Lüscherz, Dorfstation, Lake Biel, Canton of Bern (Switzerland; Photo: Archäologischer Dienst des Kantons Bern, B. Bedha).*

# Exploitation of carnivores for clothing: evidence of carnivore skinning from the Palaeolithic of Europe

Ivo Verheijen

**Zusammenfassung**

Ausbeutung von Karnivoren für Kleidung: Belege für das Häuten von Karnivoren aus dem Paläolithikum in Europa

*Die Entwicklung von Kleidung ist ein entscheidender Faktor beim Verständnis der menschlichen Expansion in kältere Regionen, aber aufgrund der Vergänglichkeit des Materials ist sie in der Archäologie immer noch ein viel diskutiertes Thema. Es wird oft angenommen, dass die ersten, einfachen Formen der Kleidung umhangartige Kleidungsstücke aus Tierhäuten waren. Um herauszufinden, welche Tierarten die Homininen für die Herstellung ihrer ersten Kleidungsstücke ausgewählt haben, können wir Schnittspuren an bestimmten Stellen des Skeletts untersuchen, die auf das Häuten von Tieren hinweisen. Verglichen mit der relativen Seltenheit von Karnivoren in einem natürlichen Ökosystem ist das Vorhandensein von Häutungsspuren bei dieser Tiergruppe im Vergleich zu Pflanzenfressern relativ hoch, was für eine Bevorzugung von Karnivorenhäuten durch (Vor-)Neandertaler und frühe moderne Menschen spricht. Die Erklärungen für die Häutung von Karnivoren reichen von funktionalen (Haardichte, isolierende Eigenschaften) bis hin zu sozialen oder sogar rituellen Gründen, die die Idee der Prestigejagd und der Signalwirkung des Tragens von Karnivorenfellen umfassen. Frühe Belege für die Häutung von Karnivoren aus dem Alt- und Mittelpaläolithikum finden sich vor allem bei großen Arten wie (Höhlen-)Bären und Großkatzen. Ab dem Jungpaläolithikum scheint es eine Verschiebung hin zu mittelgroßen und kleinen Arten, einschließlich Caniden und Musteliden, zu geben, was mit den verfeinerten Schneidereiwerkzeugen wie Nadeln zusammenhängen könnte.*

**Schlagwörter** Enthäutung, Fell, Paläolithikum, Jagd, große Karnivoren

**Summary**

*The development of clothing is a critical step in understanding human expansion into colder regions, but due to the perishable nature of the material, it is still a widely debated topic in archaeology. It is often assumed that the first simple forms of clothing consisted of cape-like garments made from animal skins. To gain insight into the animal species that hominins selected to produce the first forms of clothing, we can study cut marks on specific locations of the skeleton that indicate skinning. Compared to the relative rarity of carnivores in a natural ecosystem, the presence of skinning marks on this animal group in comparison to herbivores is relatively high, arguing for a preference for carnivore skins by (pre-)Neanderthals and early modern humans. Explanations for why carnivores are selected for skinning range from functional (hair density, insulating properties) to social or even ritual reasons, fuelling the idea of prestige hunting and the signalling quality of wearing carnivore pelts. Early evidence for carnivore skinning from the Lower and Middle Palaeolithic is primarily found on large species such as (cave) bears and big cats. From the Upper Palaeolithic onwards, there seems to be a shift towards mid-sized and small-sized species, including canids and mustelids, which could be related to the availability of more refined tailoring tools such as needles.*

**Keywords** Skinning, fur, Palaeolithic, hunting, large carnivores

## Introduction

One of the major obstacles for hominins to overcome in north-western Europe, even during interglacial conditions, was maintaining their body temperature. Evidence of occupation during different climatic conditions – similar to or colder than today – implies that hominins were able to cope with wind chill, low temperatures, reduced daylight hours, and snow cover (Hosfield 2016). Cultural solutions, such as clothing, are often assumed to be the answer to these challenges, although direct evidence of clothing is very rarely found due to the perishable nature of the materials garments were made from (Nowell/Skala 2024). It is often assumed that the first simple forms of clothing consisted of cape-like garments made from animal skins (Gilligan 2010; Collard et al. 2016). Several indirect lines of evidence, for example, the occurrence of tools related to hide working and tailoring or the emergence of clothing lice (Toups et al. 2011), are used to predict the timing and development of different types of clothing. One of the early examples of flint

**Fig. 1** Cave bear metatarsal bone with skinning marks from the Lower Palaeolithic site of Schöningen, Helmstedt District.

***Abb. 1*** *Metatarsus eines Höhlenbären mit Häutungsspuren von der Fundstätte Schöningen, Lkr. Helmstedt, aus dem Altpaläolithikum.*

scrapers displaying use-wear related to hide working comes from the site of Hoxne, Suffolk County (United Kingdom), which dates to Marine Isotope Stage (MIS) 11 and is roughly 400 ka old (Keeley 1993; Gilligan 2010). Although the presence of plants with tanning properties at an archaeological site does not prove their use, there is at least one clear indication of the use of plants for tanning by Neanderthals: a residue of a tannic paste is present on both surfaces of an approximately 200 ka old flint blade from Neumark-Nord, Saalekreis District (Koller/Baumer 2010). Besides that, the plant fibre residues found on a retouched flake from Schöningen site 12 II-4 (ID 17922), Helmstedt District, could also be the relict of a plant-based tanner (Rots et al. 2015).

With the increasing number of taphonomic studies of bone surface modifications over the last decades, a growing body of evidence demonstrates that the practice of skinning is more widespread and goes back further in time than previously thought. A large number of these studies actually consist of evidence for large carnivore skinning. Lower and Middle Palaeolithic sites from the northern expansion from (pre)Neanderthals, such as Boxgrove, West Sussex (United Kingdom; Parfitt 1999), Bilzingsleben, Sömmerda District (Brasser 2017), Schöningen (Verheijen et al. 2023), and Taubach, City of Weimar (Bratlund 1999), but also from the rest of Europe (Romandini et al. 2018; Toniato et al. 2024), show that bears were, amongst others, exploited for their skins. Besides that, the exploitation of lions for their skins is prevalent from sites such as Gran Dolina TD10.1, Province of Burgos (Spain; Blasco et al. 2010), Einhornhöhle, Göttingen District (Russo et al. 2023), and La Garma, Province of Cantabria (Spain; Cueto et al. 2016).

## Skinning, fur exploitation and hunting of carnivores

If the skin of a large carnivore is exploited, it is likely that the animal was hunted rather than scavenged. Preserving the hair on the skin ensures the insulating properties of the skin. It is only possible to exploit a fully intact skin with all the hair in place when a carcass is still in a fresh state. After a few hours in warm conditions, or after a maximum of one day in colder conditions, the skin of a carnivore will start to deteriorate. This starts with hair slippage, which will eventually lead to a total loss of all hairs, making the fur unusable.

To further support the hypothesis of hunting, reconstructions of the age-at-death profiles of archaeological assemblages are used. In nature, young animals and animals with a very advanced age have a higher chance of dying from a natural cause, such as disease or predation by carnivores. Human hunter-gatherers seem to focus more on prime-aged adult individuals (Stiner 1990). If these are over-represented in an archaeological assemblage, and especially if they also show signs of butchery, it often implies that they were

hunted. In the case of bears from Lower and Middle Palaeolithic open-air sites, we see exactly this over-presentation of prime-aged animals (Verheijen et al. 2023). Moreover, a recent study demonstrated that Neanderthals were hunting cave lions as well through evidence of a hunting lesion caused by a wooden-tipped spear combined with skeletal cut marks (Russo et al. 2023).

Although the hunting of large carnivores has been evident at least since the late Lower Palaeolithic, it should not be assumed that this was always to gain access to the skin. Based on our modern conception of animals, there seems to be a bias in which types of animals we see as prey for consumption and which are seen as raw materials for fur. This is especially prevalent in the distinction between herbivores and carnivores, as in modern western societies, mammalian carnivores are often not consumed anymore as a food resource. Nonetheless, historically and in non-western societies, the consumption of carnivores is more common, and archaeological evidence shows that in the past, the consumption of carnivores was a widespread phenomenon (e.g. Blasco et al. 2010; Romandini et al. 2018; Toniato et al. 2024). A recent study demonstrates that on the Iberian Peninsula, a whole range of carnivores was consumed by hominins from the Lower until the Upper Palaeolithic (López-Páres/Cáceres 2025). This shows that having cut marks on fur-bearing animals is not necessarily a sign that these animals were hunted for their skins only, and from that perspective, the location of the cut marks on the skeleton is crucial for discerning between skinning and defleshing/disarticulation for consumption. In most cases, cut marks related to skinning are located on parts of the body where little meat and fat are present, for instance, on the external surface of the skull and around the fore- and hind paws, including circumferential cuts around lower limb bones. Cuts from skinning are usually finer than cuts made for disarticulation and are positioned differently than defleshing marks, whereas the latter are located on the areas of the body where more meat and fat are concentrated.

**Fig. 2** Reconstruction of *Homo heidelbergensis*, wearing a cape-like ›simple‹ form of clothing, made from a bear skin.

***Abb. 2*** *Rekonstruktion des* Homo heidelbergensis, *der eine umhangartige, »einfache« Kleidung aus Bärenfell trägt.*

## Practical versus symbolic considerations

Whether the selection of carnivores, in general, and large carnivores specifically, was a deliberate choice relating to the quality of the fur or if they were selected for symbolic reasons, is difficult to judge from an archaeological perspective. When it comes to the practicalities of skinning large carnivores, it would be much less time-consuming if a hunter ignored the skin of the paws and head and just cut the skin around the wrists and neck of the animal. In contrast, the archaeological record shows that cut marks do appear on phalanges and the skull from early on, meaning that these parts were skinned too. At the Upper Palaeolithic cave site of La Garma, nine cut-marked terminal phalanges of a cave lion were found in close association (Cueto et al. 2016). The find is interpreted as the remains of a lion skin, including the claws, that was left in the cave. Similarly, the find of a third phalanx of a cave lion with cut marks from the Einhornhöhle in Germany, dating to the Middle Palaeolithic, might be the relict of a comparable context (Russo et al. 2023). Based on the sum of archaeological contexts where remains of carnivores were found with skinning marks on the skull and the complete paws, it is not far-fetched to suggest that preserving characteristic features of the animal (paws with claws and the head) might have had symbolic meaning.

## Upper Palaeolithic use of carnivore furs

Whereas evidence of carnivore skinning from the Lower and Middle Palaeolithic is primarily found on the remains of large cats and bears, from the Upper Palaeolithic onwards, early modern humans seem to exploit a larger range of carnivores, including smaller felids, canids, and mustelids (Collard et al. 2016; López-Páres/Cáreres 2025). Two reasons for this shift can be hypothesized: perhaps the hunting techniques of AMH were more advanced compared to Middle Palaeolithic hominins, enabling them to target smaller, fast-moving prey such as mustelids, felids and canids; alternatively, it could be that small carnivores only became interesting species to hunt after techniques in garment making had developed further in order to produce the so-called complex form of clothing, after the introduction of needles (Gilligan 2010). The latter hypothesis would be a much more functional interpretation of the use of carnivores for clothing, in contrast to a more symbolic meaning as hypothesized for the skins of large carnivores where evidence suggests distinct features of the animals (claws/heads) are retained.

## Conclusion

Early evidence of skinning shows that large carnivores were preferred as prey animals for obtaining high-quality furs. The insulating properties of large carnivore skins make them very suitable for producing so-called simple clothing. To obtain these furs, hominins most probably hunted rather than scavenged large carnivores. Skinning marks left on the bones from the paws and the skull indicate that these animals were fully skinned, retaining characteristic features such as the face and the paws, possibly with claws. This phenomenon is continued throughout the Upper Palaeolithic and might have had symbolic meaning, since preserving these features has no apparent practical advantages. From the Upper Palaeolithic onwards, we witness a shift towards the hunting of smaller carnivores for their fur, possibly related to the production of more complex forms of clothing items.

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# Tannage technologies available for clothing in prehistory

Theresa Emmerich Kamper and Linda Hurcombe

**Zusammenfassung**

Gerbetechnologien für Kleidung in der Vorgeschichte

*Die Bedeutung von Technologien zur Verarbeitung von Häuten für die Geschichte und die Verbreitung der Menschheit auf dem Planeten kann gar nicht hoch genug eingeschätzt werden. Frühe Gerbetechnologien sind oft schwer zu identifizieren, aber das Wissen darüber ist sowohl archäologisch nützlich als auch für die Konservierung von Artefakten von Bedeutung. Dieser Beitrag beschreibt eine systematische Analysemethode, die auf diesen speziellen Materialtyp ausgerichtet ist, mit dem Ziel, die in der Vorgeschichte verwendeten Gerbtechniken anhand von archäologischen Funden aus verarbeiteten Häuten zu bestimmen. Die Methodik ist das Ergebnis makroskopischer und mikroskopischer Beobachtungen an einer Referenzsammlung mit über 200 Proben. Diese wurden verwendet, um eine Datenbank mit definierenden Merkmalen von und Hinweisen auf jedes der sechs gängigen Gerbverfahren zu erstellen: nasses und trockenes Hirngerbverfahren, Rindengerbung, Alaungerbung, Uringerbung und Rohleder. Die Mustersammlung umfasst 22 ökonomisch bedeutende Spezies aus Europa und Nordamerika sowie eine Sammlung von häufig benutzten Kleidungsstücken und Gebrauchsgegenständen, die traditionell aus verarbeiteten Häuten hergestellt wurden.*

*Diese Forschung hat gezeigt, dass archäologische Funde aus verarbeiteten Häuten Aufschluss über die in der Vorgeschichte verwendeten Gerbetechnologien sowie detailliertere Informationen zu Herstellungsabläufen und Nutzungsbedingungen, denen ein Objekt unterworfen war, geben können.*

**Schlagwörter** Prähistorisches Leder, Pelz, Hautverarbeitung, Häute, Gerbtechnologie

**Summary**

*The importance of skin processing technologies in the history and dispersal of humankind around the planet cannot be overstated. Past tanning technologies can be hard to identify, yet the knowledge is both archaeologically useful and can inform the conservation and ongoing curation of artefacts. This contribution outlines a method of systematic analysis targeted at this specific material type, with the goal of determining the tanning technologies in use during prehistory from extant archaeologically recovered processed skin objects. The methodology is a product of macroscopic and microscopic observations of a sample reference collection containing over 200 samples. These were used to produce a database of defining characteristics and tendencies for each of six tannage types: wet and dry scrape brain tan, bark tan, alum taw, urine tan and rawhide. The sample collection comprises 22 economically important species from Europe and North America, as well as a collection of well-used clothing and utilitarian items made from traditionally processed skins.*

*This research has demonstrated that archaeologically preserved objects made from processed skin can provide information about the tannage technologies used during prehistory, as well as more detailed information such as manufacturing sequences and the conditions of use to which an object was subjected.*

**Keywords** Prehistoric leather, fur, skin processing, hides, tanning technology

## Introduction

Clothing is amongst the rarest of archaeological finds and yet it is a fundamental part of human material culture and a necessity in many climates. In the USA, where the author Theresa Emmerich Kamper was raised, the process of tanning is still part of traditional knowledge. Her background as a traditional tanner led her into academia to research the time-depth of this ancient skill. She realised that although archaeological leather was being researched, a standardised method for identifying early tannage technologies was unavailable. Using extensive archaeological research and practical experiments drawing on over 25 years of her tanning experience, she developed a new method to distinguish prehistoric tannage technologies so that their time-depth and distribution could be better understood (Emmerich Kamper 2020). The second author Linda Hurcombe researches prehistoric artefacts and experimental archaeology and takes a special interest in perishable material culture, which she terms ›the missing majority‹ (Hurcombe 2007; Hurcombe 2014).

For this paper, these complementary interests serve to present the practical aspects of tanning technologies for Stone Age clothing. The authors are actively researching collections where this approach proves useful. The topic crosscuts archaeological interest in clothing for prehistorians, curators, and conservators.

| Available prehistoric skin processing technologies | | |
|---|---|---|
| | Chemistry | Behavioural characteristics |
| Rawhide | Skin that has been fleshed, slipped (de-haired using lye or controlled bacterial activity), or shaved, then rinsed and dried. | Stiff, shrinks up to 30 % as it dries, can be heat shaped or cold formed, can be made opaque or translucent. |
| Fat emulsion processed leather | Lipids are introduced to spaces in the dermal network where, depending on the saturation level of the lipid and the warmth produced during the softening process, oxidise to various degrees. This oxidation produces aldehydic compounds which react with the collagen matrix, supporting the collagen structure, and preventing its collapse and the re-sticking of the fibres which would accompany this collapse (Covington 2011, 317). | Soft, very flexible, stretchy, windproof, washable, water permeable, resistant to mild alkaline and acid (sweat). |
| Vegetable tanned leather | Tannins suspended in aqueous solutions slowly penetrate the hide. Tannins possess phenolic hydroxyls which react with the collagen peptide links via hydrogen bonding, and secondarily, depending on pH, can fix to amino and carboxylic acids groups on the collagen side chains (Bickley 1991; Khanbabaee/van Ree 2001; Reed 1972; Reed 1966; Covington 2011). These bonds formed with the collagen, effectively cross-link the dermal fibres as well as deposit solid aggregates of tannin particles between the fibres, which prevents the collapse of the capillary structure (Reed 1972, 78). | Flexible, little stretch, dense, wind proof, can be treated to be water resistant, resistant to heat, can be heat shaped, invulnerable to bacterial decay. Is more susceptible to acid rot (i.e. sweat) and thin skins tear more easily than emulsion processed leathers. |

**Tab. 1** Available skin processing technologies in prehistory and their behavioural characteristics.

***Tab. 1*** *Verfügbare Hautverarbeitungstechnologien in der Vorgeschichte und ihre Verhaltenseigenschaften.*

Clothing provides protection from environmental conditions and bodily harm whilst also providing a powerful means of conveying social identities. Processing leather for clothing is a highly specialised subset of an extensive range of uses for processed skins. The tanning technologies utilised must produce material that is both soft enough to wear and able to remain so despite repeated wet and dry cycles. Producing clothing is likely to have been a significant factor in the day-to-day lives of ancient peoples. This has historically been an overlooked and underappreciated archaeological technology in part due to difficulties of preservation and in discerning traces of production, apart from investigation of use-wear traces which have led to ethnographic documentation (e.g. Audoin-Rouzeau/Beyries 2002; Beyries 2008; Beyries et al. 2024).

Whilst much has been written on skins, fur, and leathers, most of the available literature has focused on topics such as animal species, patterns, stitching, and decoration rather than how the skin was processed or has focussed on more recent tanning technologies, which better adhere to the parameters for modern definitions of leather (Calnan/Haines 1991; Thomson 2006). In contrast, the emphasis here is on the more ancient, more consolidated skin processing technologies. By ›more consolidated‹, we mean that processes that are separated into individual steps in modern tanning practice are instead, in traditional methods, consolidated into one or two processes.

This research defines skin processing as ›the preservation and manipulation of animal skins to prevent decay and produce a material which is suited to its required task‹. This contribution aims to 1) provide an overview of available skin processing technologies for the time period, 2) outline the practical steps and choices within these technologies, and 3) explain the behavioural characteristics each tanning technology provides for making functional clothing.

## Methodology

Though the preservation of processed skin in an archaeological context is rare, it is found often enough to provide a reasonable array of examples from which to theorise about how, when and where various tanning technologies arose. Previous research (Emmerich Kamper 2020) outlines the archaeological evidence for extant rawhide and fat-emulsion processed leather (from 10 000 years ago to the present), with skin processed using vegetable tannins as a much later technology in Europe (from 4000–5000 years ago to the present). A brief outline of these three processing technologies is shown in Tab. 1.

The existing examples of processed skin items provide a unique opportunity to investigate this set of complex and diverse technologies. At present, the analysis of these finds is often descriptive, giving good information

on dimensions, appearance, stitching and patterning, as well as thoughts on what the item may have been when in use. In many cases, analysis is hampered by the fragmentary state of the finds, and, while important, the appearance of archaeological skin products often can discourage interest and research in the subject in favour of more visually appealing commonly found artefacts. What has been lacking for these items is solid identification of the tanning technologies.

The method developed (Emmerich Kamper 2020) helps to fill this information gap by providing a systematic and standardised way of analysing and discussing these technologies using commonly available equipment, alongside extensive and systematic reference collections, as a method for differentiating between past tanning technologies. A brief outline is provided here.

Although this paper focuses on three of the following six processing methods, secure identifications rest on knowing the characteristics of each. This methodology employs observations of an extensive sample reference collection, both macroscopic and microscopic, to produce a database of defining characteristics for six tannage types or subtypes: rawhide, fat emulsion processed (wet scrape), fat emulsion processed (dry scrape), urine tan/treatment, vegetable tan, and alum taw.

The primary collection contains 22 key species identified as economically important from Europe and North America. These include bighorn sheep *(Ovis canadensis),* bison *(Bison bison)*, black bear *(Ursus americanus)*, coyote *(Canis latrans),* elk *(Cervus canadensis),* mule deer *(Odocoileus hemionus)*, pronghorn antelope *(Antilocapra americana)*, Exmoor pony *(Equus ferus caballus)*, fallow deer *(Dama dama),* Galloway cow (*Bos taurus*), roe deer *(Capreolus capreolus),* red deer *(Cervus elaphus),* Soay sheep *(Ovis aries)*, Toggenburg goat *(Capra aegagrus hircus)*, wild boar *(Sus scrofa)*, badger *(Taxidea taxus),* beaver *(Castor Canadensis),* dog *(Canis lupus familiaris),* red fox *(Vulpes vulpes),* moose *(Alces alces),* rabbit *(Sylvilagus* sp.*)*, and reindeer *(Rangifer tarandus)*.

A secondary collection of clothing and utilitarian items made from traditionally processed skins was included to add ›in-life‹ use traces to the database. These behavioural characteristics are included as part of the methodology because they are specific to the tannage type. Because they are set in place during the object's use life, post-depositional changes, such as over-tannage from bog interment, affect this set of characteristics very little. For a full description of the geographical, chronological, and technological parameters of this methodology, see Emmerich Kamper 2020, 18.

The method was tested against archaeological items from a variety of preservation contexts and ethnographic items from museum collections across North America and Europe. This analysis confirmed that defining characteristics do exist between the primary tannage technologies and that at least some defining characteristics survived in all preservation contexts. These can be recorded at multiple levels of observation and often provide detail into aspects of the artefact's production sequence and life history. This research shows definitively that processed skin items from vastly different preservation contexts can provide a wealth of information about prehistoric tannage technologies, as well as information on manufacturing sequences and the conditions of use an item experienced.

The method is a valuable analytical tool for those involved in the conservation, curation or analysis of archaeological or world culture collections of skin objects. It provides a consolidated source of information for artisans working with traditional tanning or re-enactors interested in the history and science of skin products.

## Processing Methods

Most skin processing methods break down into three stages: subtractive, additive, and mechanical. The variations and terminology within these are described below with the help of Fig. 1, showing the skin structures and dermal layers, and Tab. 2, 3 and 4, which outline the subtractive, additive, and mechanical stages of skin processing. The subtractive stage removes unwanted components such as the subcutaneous tissue, hair, or the grain layer. These are often referred to as pre-processes or pre-tanning processes. The additive stage introduces reactive compounds (i.e. the fat emulsion or vegetable tannins). This is the stage where most chemical processes happen and is the stage most often referred to as ›tanning‹. The mechanical stage involves repeatedly moving the fibres of the dermis past each other so that they do not set or harden as the skin dries or in order to loosen a fibre structure after it has dried.

The epidermis is the outermost layer of the skin (Fig. 1). This thin but complex layer is broken down bacterially or chemically and is not present on de-haired skins except as an anomaly. The underlying papillary dermis is composed primarily of connective tissue, specifically collagen fibres, made of the same structural proteins (collagen type 1) that are the main component of the rest of the dermis. This layer is also referred to as the grain layer and is composed of very fine, densely packed fibres. The upper layer of the papillary dermis gives the grain (outer) surface its smooth, reflective quality, whereas its removal leaves a double-sided ›suede‹ finish. The underlying dermal layer is the reticular dermis and is composed of thicker and more loosely interwoven dermal fibres. There is a transition zone between the deeper reticular dermal layer and the papillary layer. When the grain layer is removed, it is at this transition zone. Removal of the grain layer is always a mechanical rather than chemical process.

Vegetable tan, in all its variation, rarely, if ever, has the grain layer removed. Emulsion-processed leather most often has the grain layer removed. However, there are examples of emulsion-processed leather both in archaeological contexts and in modern indigenous communities where the grain layer is left intact. Many arctic communities do not remove the grain before tanning sea mammal skins (e.g. Issenman 2011; Wilder 1976; Oakes/Riewe 1995). The Saami regularly produce grain-on emulsion processed reindeer skins (Rahme 1996; Klokkernes/Kunstakademi 2007), and some artefacts observed during the author's fieldwork in Europe and North America were grain-on emulsion-processed leather.

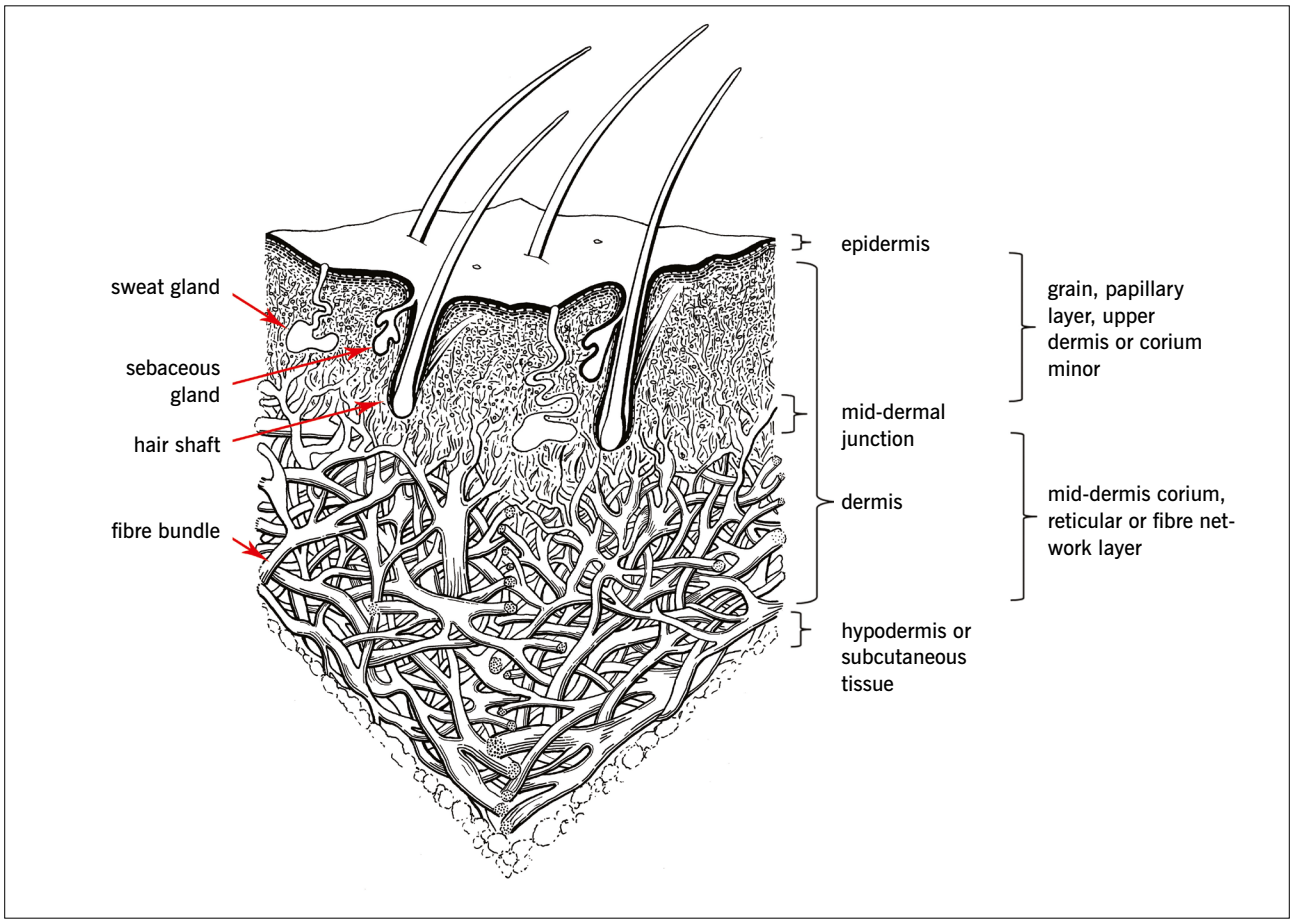


**Fig. 1** Cross section of generic mammal skin showing dermal morphology.

***Abb. 1*** *Querschnitt durch die generische Haut eines Säugetiers mit Darstellung der dermalen Morphologie.*

## Subtractive Stage

Several general reductive treatments are performed on a skin prior to the more specific additive treatments that characterise each processing technology. This subtractive stage is defined by something being taken away from the skin: removing subcutaneous tissue (de-fleshing), hair, epidermis, grain layer (papillary dermis), and the ground substance are all subtractive steps. How and if some or all these steps are undertaken is influenced by environment, location, time-period, and cultural traditions (Tab. 2).

## Additive Stage

The additive stage of skin processing has perhaps the most variation of any tanning stage. This stage is defined by the addition of reactive substances that interact with the structural proteins of the dermis to change its visual and behavioural characteristics. The reactive agents are most often introduced to the dermal tissue in one of two ways: by rubbing moist mixtures into dry, semi-dry or wet skins or immersing the skin into a solution containing the reactive agents. Water is necessary as a transportation aide for the reactive substances for all tannage technologies (Tab. 3).

## Mechanical Stage

The mechanical stage of skin processing is concerned with manipulating the fibres of the dermis so that they retain a level of flexibility as the skin dries or regain some flexibility if this step is done after the skin has dried. Softening the skin is achieved by manipulation of the fibre structure in all directions until the dermis loses all moisture. Dried skins are commonly remoistened before undergoing this process (Tab. 4).

The species for the reference collection had to cover a global reach, but more importantly, the collection had to include the range of species available in different periods and utilised for various products. Species differ in their suitability for the three tannage technologies known to be available in prehistory. Three characteristics need to be considered for the available species, which are outlined in their potential for clothing.

The first is the choice to keep or remove the hair/fur. The thermal qualities of fur made some species more attractive than others. Water mammals, in particular, such as beaver and otter with their dense fur (i.e. numerous hairs per square centimetre) are highly suitable to providing warmth. Some furs shed water more easily than others. Both warmth and water shedding could be reasons for the selection of certain species to use for clothing. The hair of most deer families

**Tab. 2** Subtractive processes: removal of unwanted components in processed skin.

***Tab. 2*** *Subtraktive Prozesse: Entfernung von unerwünschten Bestandteilen der verarbeiteten Haut.*

| | Subtractive stage |
|---|---|
| **De-fleshing** | The mechanical removal the subcutaneous tissue made up of flesh, fat and connective tissue is a ubiquitous step in all skin processing, including rawhide. These tissues rot rapidly degrade the dermal tissue beyond use. Can be done with the skin in a dry or wet state. |
| **De-hairing and de-graining** | **General overview:**<br>The removal of the hair/fur while leaving the grain layer (papillary dermis intact) or the removal of the grain layer and the hair/fur. Removing the fur or hair from some species, but not from others is based on the intended final use for the skin. Removal of the grain layer is common for emulsion processed skins as it facilities the penetration of the emulsion. This step can be omitted if the intended product requires a more water-resistant surface and does not require the same amount of drape (flexibility and stretch) as can be achieved by its removal. This is commonly done in one of three ways. |
| | **1-Mechanical:**<br>• Hair can be shaved off with a sharp stone or metal tool with the skin in a dry state, while leaving the grain layer intact.<br>• The grain layer and hair can be simultaneously removed using the same method.<br>• The grain layer and hair can be removed from a wet skin by laying the skin over a tanning beam and scraping it with a tool with a distinct but dull edge. |
| | **2-Bacterial:**<br>• Allowing skin to rot in a controlled manner breaks down the keratin-rich epidermal layer and loosens the hair root. Commonly referred to as ›sweating‹, the hair can then be pulled out or pushed off the skin, leaving the grain layer intact.<br>• If the grain layer is to be removed, it must be scraped off mechanically as stated above. |
| | **3-Chemical:**<br>• A more easily controlled method of hair removal uses alkaline pH to slip the hair. An alkaline solution breaks down the epidermal keratinocyte layers and allows the hair to loosen in the follicle.<br>• Potassium hydroxide, the alkaline component in wood ash, was a readily available material for the time period and well documented in indigenous cultures as a de-hairing and degreasing agent.<br>• If the grain layer is to be removed, it must be scraped off mechanically as stated above. |
| **Ground substance removal** | Ground substance is the extracellular matrix that exists between the collagen fibres and other structural proteins. Most of which is removed in all skin processing technologies, except for in rawhide. The less ground substance present, the softer and more flexible the product. A desirable trait for most clothing.<br><br>Ground substance can be removed by:<br>• Mechanically via intensive scraping and washing.<br>• Bacterially via enzymatic action.<br>• Chemically via changes in the solubility of the proteins. |

breaks off easily, making it less suitable as a hair-on skin than species with a solid hair shaft. In contrast, the leather made from de-haired deer skin is one of the most versatile for clothing manufacture. Reindeer skins with the hair on (intended for clothing, rather than any other purpose) are best harvested in the late summer or early autumn, as the winter coat is too warm and the hair is too brittle to produce optimum garments.

The thickness and the looseness of the fibre structure of the dermis are a consideration both for the tannage technology employed and the type of clothing that could be produced from it. Thick skins with a dense, tight fibre structure, such as cow, are better suited to vegetable tan or rawhide, whereas a thick skin with a loose fibre structure, such as bison or moose, can be processed using emulsions to provide

| | Additive stage |
|---|---|
| **Rawhide** | No reactive agents are used for preparing rawhide. |
| **Emulsion processed leather** | brain, egg yolk, fish oil, marine mammal fat, milk, fish roe<br>• liver, spinal fluid, tallow<br>• used in addition to the more common agents |
| **Vegetable tanned leather** | A wide range of species containing tannins exist in each environment. Use is based on availability and characteristic preference.<br><br>Some common species are:<br>• bark/wood: oak, chestnut, spruce, larch, birch, acacia, quebracho<br>• roots: dock, tormentil, rhubarb<br>• fruits/rinds/oods: acorns, acacia, tara, mimosa, coffee, galls<br>• leaves: sumac, olive, acacia |
| **Smoke** | Smoke is antimicrobial, slows bacterial, fungal decay and deters insect predation of the finished product. Only emulsion processed skin and occasionally rawhide is smoked. Skins processed with oils/fat emulsions, are more versatile after smoking in that they better withstand repeated wet and dry cycles. The temperature of the smoke is unimportant if the skin is exposed for a long enough span of time.<br><br>Some common smoking methods are:<br>• Hanging in a smoke house or the rafters of a shelter.<br>• Being sewing it into an open-ended bag and placed over a stove pipe or hole in the ground. |

**Tab. 3** Additive processes: common reactive agents for prehistoric processed skin.

***Tab. 3*** *Additive Prozesse: gängige reaktive Substanzen für prähistorische verarbeitete Haut.*

a soft, lightweight product. Some smaller animals have very thin skin, which, while able to be processed using any of the available technologies, can be fragile. Small skins from birds and hare may be used where larger animals are less available, or where their thinness is an advantage, such as for children's clothing. At the other end of the scale, larger animals, such as bison, have areas of very thick skin that are commonly cut out or used for items that must withstand substantial mechanical stress, such as shoes. However, for robes or tent skins, thick areas are thinned during the subtractive stage by scraping away layers of tissue as a way of reducing weight.

For clothing, the animal's overall size can also influence its use. Animals in the deer size-range strike a good balance between size in square metres and thickness of the dermal tissue. Smaller animals require less effort to tan, but more time is spent sewing, and more complex patterning is necessary. Environmental conditions dramatically influence both the species used and the tannage technology chosen. In dry conditions, emulsion-processed skin and rawhide have good longevity. The traits of emulsion-processed leather work well for clothing as the skins range from flexible to very soft and are lightweight, breathable, resistant to acidic conditions (sweat), and can be easily sewn and washed. In contrast, skins processed using vegetable tannins weigh more, are less breathable, and must be re-oiled after washing. However, they can be oiled or waxed on the grain side surface to repel water, have a higher heat resistance and are non-putrescible in situations where the skin stays wet for long periods of time. Behavioural characteristics of the different tannage technologies and their influence on clothing design and choice will be further expanded in future publications.

## Conclusion

We have provided a brief overview of the skin processing technologies for the period covered by this volume. The steps have been outlined as a series of choices, and we have endeavoured to show how these selections have carried through into the characteristics of the clothing produced from them. The availability of the various animal species has implications for insulation, flexibility, pattern layout, and stitching time. Here, we have shown that when considering the choices made by prehistoric groups, there is a complex interplay between both the environment as the climate in which humans need to survive and the environment as the opportunity to acquire those faunal resources needed as raw materials.

Many of the characteristics are determined by the tanning technologies chosen and can provide very different

**Tab. 4** Mechanical processes: common methods of imparting flexibility to processed skin.

***Tab. 4*** *Mechanische Prozesse: gängige Methoden, um verarbeiteter Haut Flexibilität zu verleihen.*

| | Mechanical stage |
|---|---|
| **Hand working** | Pulling or pushing skins in all directions using the tanner's feet, knees, and hands. Commonly used for thin or loose fibred skins. |
| **Staking** | Pulling or pushing skins over a solid post with a blunt U-shaped end or pulling them through a cable fixed at both the top and bottom, or a similarly through a fixed bone or wooden D shaped tool secured to a solid object. |
| **Frame working** | Lacing a skin into a wooden frame or hoop. The fibre structure of the skin is moved by pushing a tool with a blunt U-shaped end into the skin and dragging it in various directions to stretch and move the fibre network. Often used for thick, hair on or very large skins. Also used to flatten rawhide as it dries. |

products. Although we have more tanning technologies at our disposal today, even the early tanning technologies provide an extensive range of different qualities which are entirely dependent on people's choices. Understanding the practical parameters allows for a much greater appreciation of the possibilities for clothing in these early periods. Leather is not simply a material, but a rich sphere of knowledge allowing us to appreciate how early societies thrived.

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## Source of figures

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Tab. 1–4 T. Emmerich Kamper

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# Feathers in Mesolithic burials

Tuija Kirkinen

**Zusammenfassung**

Federn in mesolithischen Bestattungen

*Es wird vermutet, dass Vögel in der Steinzeit nicht nur wegen ihres Fleisches, ihrer Eier und ihrer Knochen von Bedeutung waren, sondern auch aufgrund ihrer Federn und Daunen. Obwohl die tatsächlichen Überreste von Federn in der Tat selten erhalten sind, gibt es indirekte Hinweise auf sie. Knochen von Vogelflügeln, die in Gräbern gefunden wurden, deuten beispielsweise darauf hin, dass diese – vermutlich mit Federn bedeckt – den Toten beigelegt wurden. Außerdem wurden Federn zum Befiedern von Pfeilen benötigt. In ethnografischen Quellen wird von Kleidungsstücken aus Wasservogelhäuten in der nördlichen Hemisphäre berichtet. In jüngster Zeit hat der Nachweis von mikroskopisch kleinen Federfragmenten in Bestattungen, die Tausende von Jahren alt sind, neue Informationen über weiche organische Materialien geliefert, die absichtlich in Gräber gegeben wurden.*

*In diesem Beitrag werden die neuesten Ergebnisse der Faseranalyse vorgestellt, die bei der Analyse einer Reihe von mesolithischen Bestattungen, d. h. der Kinderbestattung von Majoonsuo, Nordkarelien (Finnland), und der Schamaninnen- und Kinderbestattung von Bad Dürrenberg, Saalekreis, eingesetzt wurden. Darüber hinaus werden einige vorläufige Ergebnisse aus den Friedhöfen Skateholm I und II, Skåne län (Schweden), vorgestellt. Die Analyse von Sedimentproben aus Bestattungskontexten zeigt, dass Federn von Wasser- und Raubvögeln am häufigsten für die Herstellung von Kleidungsstücken, Kopfbedeckungen und möglicherweise für die Ausstattung des Grabes verwendet wurden. Der Artikel unterstreicht die Bedeutung und Notwendigkeit systematischer Beprobungen für zukünftige Forschungen.*

**Schagwörter** Mikroarchäologie, Federn, Sedimentproben, Bestattungen, Mesolithikum

**Summary**

*Birds are presumed to have been important in the Stone Age not only for their meat, eggs, and bones but also for their feathers and down. Although the actual remains of feathers are rare indeed, there is indirect evidence for feathers. For example, bird wing bones detected in graves imply that bird wings – presumably covered in feathers – were placed with the dead. Moreover, feathers will have been needed for fletching arrows. In ethnographic sources, garments made from waterfowl skins have been reported in the northern hemisphere. Recently, the detection of microscopic feather fragments in burials spanning thousands of years has provided new information on soft organic materials deliberately placed in graves.*

*This paper presents the latest results of fibre analysis implemented in the analyses of a series of Mesolithic burials, i.e. the Majoonsuo child burial, North Karelia (Finland), and the Bad Dürrenberg, Saalekreis district, shaman and child burial. In addition, some preliminary results from Skateholm I and II cemeteries, Skåne county (Sweden), will be presented. Analysis of sediment samples from burial contexts indicates that feathers of waterfowl and birds of prey have been used most frequently for making garments, headgear, and possibly furnishing the grave. The paper highlights the importance and need for systematic sampling in future research.*

**Keywords** Micro-archaeology, feathers, sediment samples, burials, Mesolithic

## Introduction

The plumage of birds consists of different types of feathers with varied functional properties related to flying, diving, and insulation. Even more, the soundless flight of an owl (Bachmann/Wagner 2011) and the drumming sound produced by the tail feathers of the Common snipe *(Gallinago gallinago)* are examples of species-typical functions of feathers. Accordingly, humans have exploited the different species and feather types by selecting the best feathers for fletching arrows and filling pillows or preparing bird skins for garments. Additionally, feathers and bird body parts, such as wings, have been used as decorative elements (Serjeantson 2009, 207); their use in ritual costumes is well described in ethnographic sources throughout the world (Konovalov et al. 2006; Lindsay Levine 1991; Pearlstein 2017a). For example, Finnish historian of religion U. Holmberg (1922, 6; 13–14; 20) documented the bird-type shaman

**Fig. 1** Bird shaman dress after U. Holmberg.

***Abb. 1*** *Kleid eines Vogelschamanen nach U. Holmberg.*

costumes in Siberia and reported that the headgear was usually made of bird feathers, and – in some cases – even from a complete owl skin. Sometimes, bird wings were also attached to the shaman's shoulders. Feathers were also imitated: wings were indicated by sewing long strips of leather onto the under-arm seam of the sleeves. Throughout the outfit, small leaf-shaped pieces of iron were interpreted as feathers (Fig. 1).

Although it is generally assumed that feathers already were important during the Stone Age, the finds themselves are extremely rare in archaeological contexts, as feathers are soft organic materials that tend to degrade over time (e.g. Hurcombe 2014, 91–92). However, zooarchaeological analyses have occasionally documented cut marks related to the removal of feathers, indicating a systematic and geographically widespread tradition of extracting feathers by Neanderthals and other Palaeolithic human groups (e.g. Finlayson et al. 2012; Fiore et al. 2020; Peresani et al. 2011). In Northern Europe, the osteological evidence of feathers is composed of wing bones that indicate the placing of complete wings in Mesolithic and Neolithic burials. The most spectacular example is the whooper swan *(Cygnus cygnus)* wing fragment (the proximal part of the right *carpometacarpus*) recovered below the burial of a baby in Grave 8 at Vedbæk, Capital Region (Denmark; Albrethsen/Brinch Petersen 1976; Mannermaa 2013a; Nilsson Stutz 2003). In another instance, at Zvejnieki, Vidzeme region, in northern Latvia, almost forty carpometacarpal bones and three wing phalanges of Eurasian jay *(Garrulus glandarius)* were found in an adult male grave (Grave 164). In this case, at least 17 jay individuals were butchered and used to decorate the burial, probably selected for their impressive wing feathers of the bright blue colour spectrum (Mannermaa 2006; Mannermaa 2013b).

For the preservation of complete feathers, special circumstances such as extreme cold or aridity, submerged or peat bog contexts are required (e.g. Rast-Eicher 2016, 15–31). For example, feathers that had been used in fletching arrows have been detected in melting glaciers worldwide (Dove et al. 2005; Junkmanns et al. 2019; Rosvold 2016). In Punta de la Peña 4, Salta Province (Argentina), a site located in the arid Andean highland, several complete feathers have been studied in a context dated to 500–1000 BP (Velardez-Fresia/Urquiza 2024). Also, in the Kagamil Cave burial site in Alaska, feathers and mammalian hairs have been preserved in contexts with mummified corpses (Dove/Peurach 2002; Funk 2018).

Occasionally, microscopic feather fragments, i.e. barbules, have also been preserved – for example, on the surfaces of lithic artefacts that have been used for processing bird skins or feathers (Hardy et al. 2001; Hardy et al. 2018; Kirkinen et al. 2023). Plumulaceous barbules, although usually only ca. 0.2–5.0 mm long, are useful finds as they not only testify to the use of feathers but can also entail diagnostic features for identification of species or genera (see Dove/Koch 2011). The finding of barbules in residue analysis (e.g. Hardy/Moncel 2011; Robertson 2002) shows that they may also survive in sediments different from grave fills.

In this paper, I will present a selection of the latest results on microscopic bird feather fragments in Mesolithic burials (Fig. 2). For this purpose, I have selected the Majoonsuo child burial, North Karelia (Finland; Kirkinen et al. 2022), and the Bad Dürrenbergshaman and child burial, Saalekreis District (Orschiedt et al. 2023). In addition, the pre-

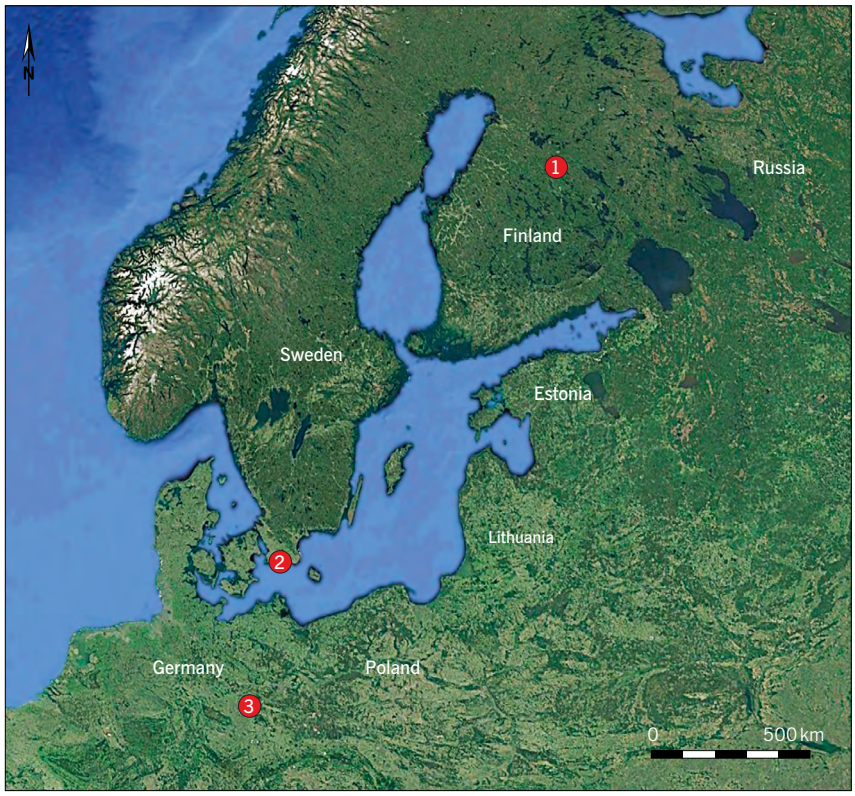


**Fig. 2** The locations of the sites discussed here. 1 Majoonsuo, North Karelia (Finland), red ochre grave; 2 Skateholm I and II, Skåne County (Sweden), burial sites; 3 Bad Dürrenberg, Saalekreis District, shaman burial.

***Abb. 2*** *Die Lage der hier behandelten Fundstellen. 1 Majoonsuo, Nordkarelien (Finnland), rotes Ockergrab; 2 Gräberfelder Skateholm I und II, Skåne län (Schweden); 3, Bad Dürrenberg, Saalekreis, Bestattung einer Schamanin.*

liminary results of Skateholm I and II cemeteries, Skåne County (Sweden; Larsson 2016), will be noted. The barbules have been detected in sediment samples that have been collected both in recent excavations and even in a research project, whose sediment samples had long been in a storage. First, the preservation of feather fragments in archaeological sediment samples is discussed, after which the three selected Mesolithic burial sites are presented as good examples for potential fibre analysis. Finally, source-critical issues related to the sourcing of microscopic barbules will be discussed.

## The preservation of feathers

The feather fragments that have been recovered in archaeological sediment samples represent the smallest elements that compose a feather; they are called barbules (Fig. 3). These barbules can measure less than one millimetre in length, while the longest ones from large birds may even be 4–5 mm long. In practice, archaeological barbule finds are often fragmented, and the smallest ones detected by sieving are only 0.2–0.3 mm long. Barbules are categorised as *pennaceous* and *plumulaceous* barbules; only the latter provide

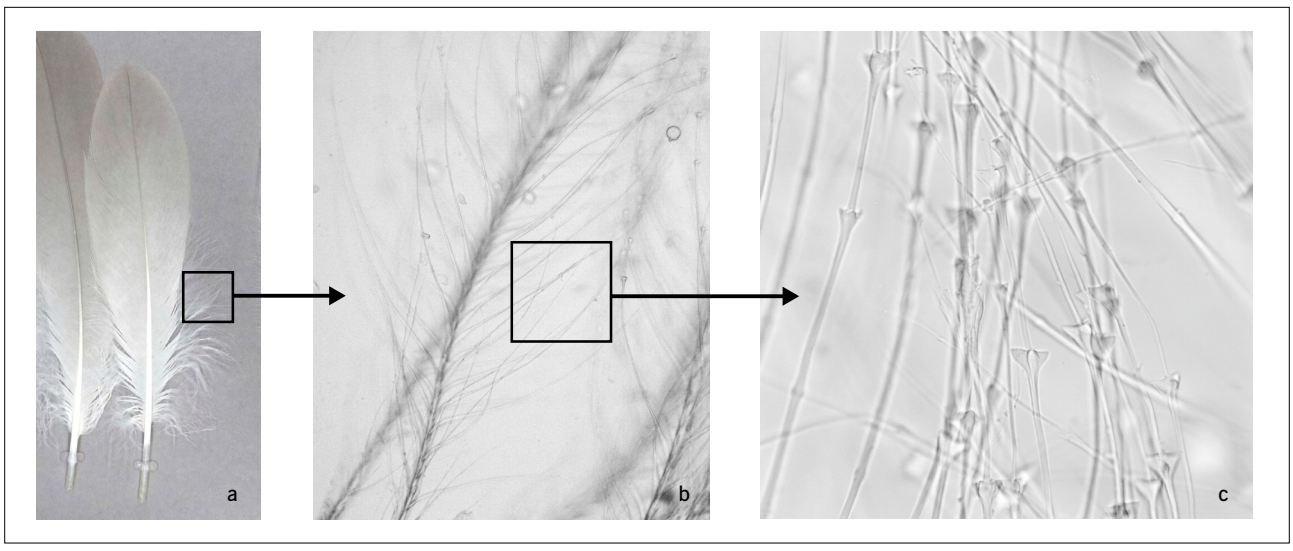


**Fig. 3a–c** Whooper swan *(Cygnus cygnus)*. a feather; b barb; c barbules with their diagnostic triangular-shaped nodes.

***Abb. 3a–c*** *Singschwan* (Cygnus cygnus). *a Feder; b Federast; c Häkchen mit ihren diagnostischen dreieckigen Knoten.*

**Fig. 4** Majoonsuo rescue excavations in 2018 by the Finnish Heritage Agency. The red formation in the middle of the photo is the uppermost level of the red ochre grave.

***Abb. 4*** *Die Rettungsgrabungen in Majoonsuo im Jahr 2018, durchgeführt von der Finnischen Denkmalschutzbehörde. Der rote Befund in der Mitte des Fotos ist die oberste Ebene des roten Ockergrabes.*

diagnostic features for species identification (see Hudon 2005; Dove/Koch 2011).

The preservation of barbules compared to other feather parts is related to their structure. Bird feathers are composed of proteins, lipids and biopigments, the proteins of which consist of keratins (Pearlstein 2017b, 6). Compared to mammalian hairs, bird feathers have a greater amount of β-keratin that is more consistent with soil microbiome than α-keratin, which is the main component of hairs (Lange et al. 2016; Schweitzer et al. 2018). Moreover, the evolutionary diversification of feathers has resulted in various keratinous components of feathers from different parts of birds and in different parts of feathers (Barone et al. 2005; Fraser/Parry 2008; Ng et al. 2014). For example, pennaceous barbules are known to be composed of specific β-keratin (Kowata et al. 2014; Ng et al. 2014), and barbules in general have also shown their resistance to microbial degradation in experimental residue analysis (Monnier/May 2019, 6818).

For the preservation of microscopic fibres in archaeological contexts, the sediment texture and pH have turned out to be among the most important factors (Kirkinen et al. 2022). In general, keratins are favoured by acidic sediments (e.g. Janaway 2001; Rowe 2020, 158; Wilson 2008). However, there is evidence that hairs and barbules can also be preserved in alkaline environments if the sediment is fine-grained, i.e. clay or silt. It seems that even small anomalies of fine-grained soil can form protective, air-free envelopes around the fibres. In Stone Age graves, red ochre also seems to have been a positive element enhancing the preservation of fibres, not only due to its clay particles but also because of its ferrous content (Kirkinen et al. 2022).

## The archaeology of barbules

Barbules or their fragments are the most numerous parts of feathers recovered from archaeological sediment samples. Due to their microscopic character, barbules, as well as animal hair and plant fibre fragments, must be separated from the sediment by water sieving. The protocol for this procedure has been described in T. Kirkinen et al. (2022). Thus far, evidence of bird feather fragments has been detected in several Mesolithic (Kirkinen et al. 2022; Mannermaa/Kirkinen 2020; Mannermaa et al. 2019) contexts, mainly in Northern Europe and Germany. In the following, examples of the research results will be presented.

### Majoonsuo

The first Mesolithic site that was studied for microscopic fibres was the grave of a 3–10-year-old child in Majoonsuo (Kirkinen et al. 2022). The grave was excavated in 2018 by the Finnish Heritage Agency as a rescue excavation (Fig. 4). The research team collected almost all the sediment from the grave fill – coloured heavily by red ochre – and from its surroundings, to be used in testing and developing the sieving method in the search for microscopic fibres.

From a total of 60 sediment bags, 23 were selected for further analysis. In each case, 150–300 g of sediment was studied for fibres. The analysis produced a single Canid hair, bast fibres, and over 20 bird feather fragments, i.e. barbules (Fig. 5). The feather fragments were especially detected at the lowest level of the grave. Most of the barbules lacked diagnostic features that could be used for species identification; some, however, could be identified as waterfowl *(Anseriformes)*, probably ducks, and one as falcon *(Falconidae)*. The falcon feather fragment was tentatively interpreted as a costume decoration or the remains of feathers used for fletching arrows placed in the grave with the child. The waterbird feathers were hypothesised to originate from a garment made of bird skins or from a layer of downy feathers that separated the deceased from contact with the surrounding sediment. In both cases, ethnographic parallels evidence similar uses of bird skins and feathers in the northern hemisphere. In Greenland and among Canadian Inuits, for example, bird skins are known to have been used especially for children's anoraks and garments due to their softness and warmth. Moreover, waterfowl skins were preferred due to their insulation properties and durability, and for children, e.g. skins of juvenile common eider *(Somateria mollissima)* were selected due to their extra softness (Buijs 2004, 16; 46; Nakashima 2002). There is also additional evidence of the relationship between children and birds; for example, C. Funk (2018) has reported that bird feathers were strongly associated with child mummies in the Kagamil Cave burial site in the eastern Aleutians, Alaska.

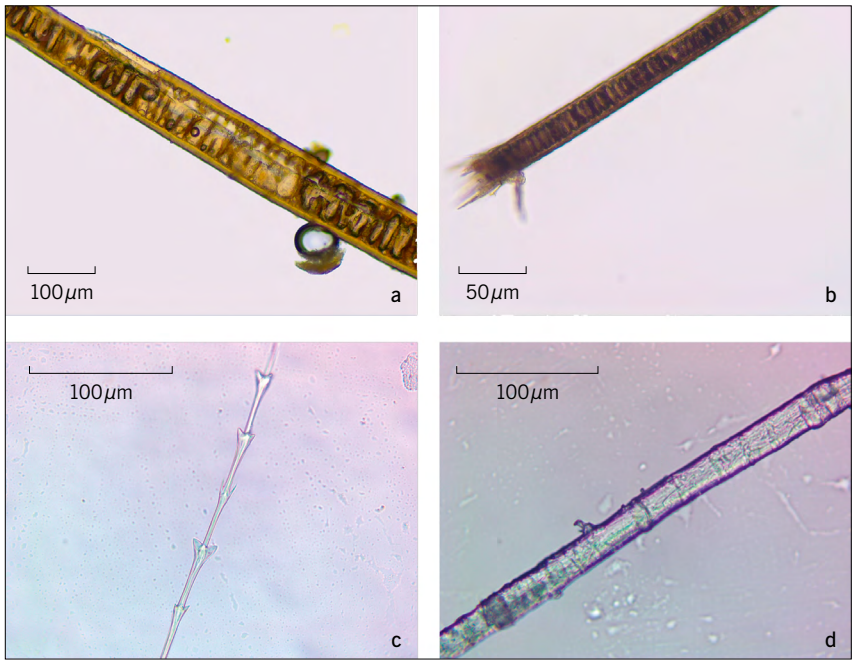


**Fig. 5a–d** Examples of fibres recovered in the Majoonsuo child burial. a canid hair; b carnivore hair; c waterfowl barbule; d bast fibre.

***Abb. 5a–d*** *Beispiele von Fasern, die in der Kinderbestattung von Majoonsuo geborgen wurden. a Haare von Hunden; b Haare von Fleischfressern; c Häkchen von Wasservögeln; d Bastfasern.*

In that cave, bird wings and a hawk skin were placed next to children, and some mummies were wrapped in shirts prepared from waterfowl skins. In addition, feathers were scattered throughout the Kagamil Cave (Dall 1877; Dove/Peurach 2002; Hrdlička 1945). These examples are presented here only to show that the many explanations are possible, and more investigation is needed to understand the roles of bird feathers in death rituals.

## Skateholm

The Mesolithic burial sites of Skateholm I and II are composed of a total of 87 graves, situated by a shallow lagoon on the south coast of Scania (Fig. 6; Larsson 2016). The cemeteries and the nearby settlement site were excavated by L. Larsson, 1980–1984; since then, this archaeological complex has been under active multidisciplinary research (e.g. Eriksson/Lidén 2002; Larsson 1988; Macāne 2022). During excavation, Larsson took 1–12 sediment samples in each grave for pollen analysis (Larsson 2016, 179). After the analysis, the remaining samples, 139 in number, were stored on the premises of the University of Lund. For this research, a collection of 58 samples from 27 graves in Skateholm I and 21 samples from eight graves in Skateholm II was analysed for fibres and feathers 2022–2024 (Kirkinen et al. forthcoming).

The preliminary results indicate the importance of waterfowl and hawks or eagles *(Accipitridae*) in these sites. The birds of prey barbules were recovered especially from the samples taken in the head and neck area. Therefore, it is reasonable to assume that hawk/eagle and owl feathers or

**Fig. 6** Skateholm I and II landscape today. In the front, the remains of a lagoon are still visible.

***Abb. 6*** *Die heutige Landschaft von Skateholm I und II. Im Vordergrund sind noch die Überreste einer Bucht zu erkennen.*

**Fig. 7** Bad Dürrenberg. Roe deer antlers, perforated and unperforated teeth of bovids and red deer, and split, worked and partly perforated wild boar canine halves. No scale.

***Abb. 7*** *Bad Dürrenberg. Rehgeweihe, gelochte und ungelochte Zähne von Boviden und Rothirschen sowie gespaltene, bearbeitete und teilweise gelochte Eckzahnhälften von Wildschweinen. O. M.*

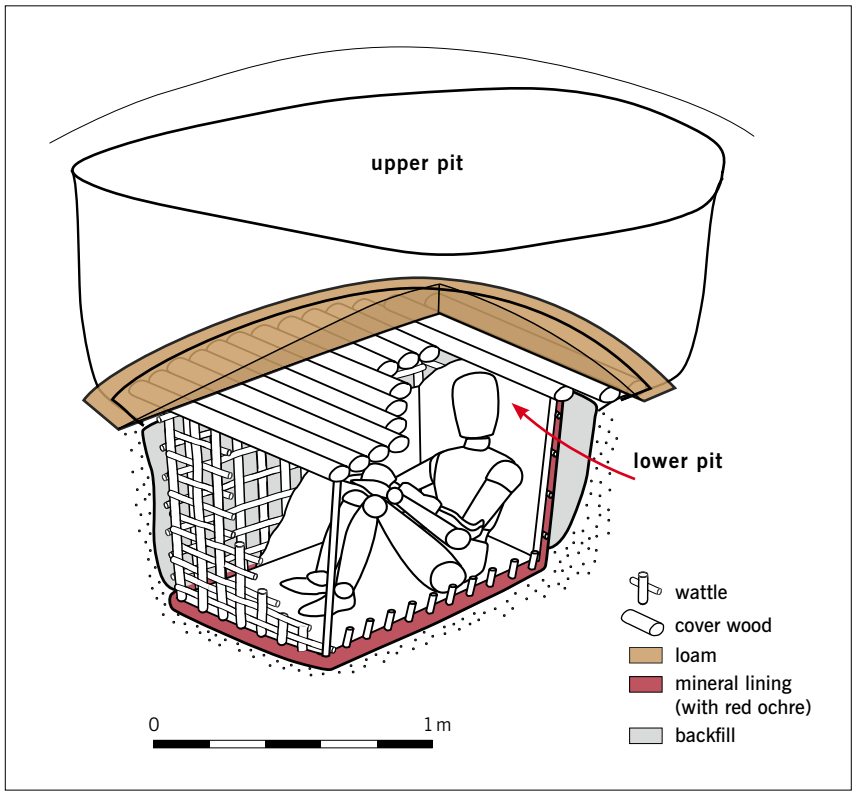


**Fig. 8** Bad Dürrenberg, reconstruction of the grave pit. The sampling spot is marked with a red arrow.

***Abb. 8*** *Bad Dürrenberg, Rekonstruktion der Grabgrube. Die Probenahmestelle ist mit einem roten Pfeil markiert.*

complete skins were used as headgear or head decorations – perhaps also attached to the shoulders. In ethnographic comparisons, headgear made of birds of prey feathers has been explicitly connected with North Eurasian shamanic dress (e.g. Burged 2023, 85; Hasanov 2016; Holmberg 1922). In particular, waterfowl feathers were detected in contact with the torso and limbs, which might indicate a similar use as in the Majoonsuo child burial (see previous chapter), i.e. for garments, loose wrappings or coverings made of waterbird skins.

Compared to the feather remains, bird bones have been recovered only rarely in Skateholm I and II burials (see Macāne 2022, 251–252). In Grave 35, a possible *Accipiter* (hawk) *phalanx* and in Grave 47, *vertebra* of *Gavia stellata* (red-throated diver) have been detected. Bird bones have also been recovered from graves 46 and IX, but in these cases their belonging to the original grave inventory is questionable. However, in Grave IX a bone attributed to *Anatidae*, found in the filling of the grave, matched the waterfowl barbules detected between the femurs and in contact with the human scapula. The lack of bird bones in graves with barbules indicates that the feathers do not originate from complete birds or bird parts, such as wings.

## Bad Dürrenberg

The famous shaman and infant burial in Bad Dürrenberg was recovered in 1934 from the construction-work trench of a water pipeline and, therefore, had to be excavated on a very tight schedule. Supposedly, the woman and child were buried in a seated position with a versatile grave inventory consisting of bone and stone tools, animal tooth pendants, and a complete roe deer *(Capreolus capreolus)* antler frontlet (Fig. 7). In addition, over one hundred pieces of mammal and bird bone fragments were included, among them crane (*Grus* sp.) humerus and tibiotarsus (Grünberg 2016; Grünberg et al. 2016).

Starting from 2019, the site was re-excavated by the State Office for Heritage Management and Archaeology Saxony-Anhalt, State Museum of Prehistory, providing important new information about the burial (Orschiedt et al. 2023). The remains of the grave were transported as a sediment block and excavated in the laboratory premises of the State Office. As part of the excavation, seven sediment samples were taken for fibre analysis from behind the head of the interred. The samples form a vertical series collected from the remaining original Mesolithic context, which has been interpreted as a backfill between the wooden wattle-like construction that supported the wall of the grave pit and the burial container, probably built of wattle, too (see Orschiedt et al. 2023, Fig. 7). This material was located outside the organic container, inside which the shaman and infant were laid to rest, covered with red ochre (Fig. 8). One of the samples was a block of undisturbed sediment located next to the shaman's head; the other samples were sieved before the analysis. In addition, two samples from an adjacent, younger – but also Mesolithic – deposition of two antler masks located ca. 1 metre west of the shaman burial were analysed. In addition, a reference sample was taken outside the grave pit.

As a result, a total of 15 bird feather fragments were detected in six soil samples. The barbules were 0.4–1.3 mm in length. One of them, located approximately at the skull level of the female, was identified as waterfowl *(Anseriformes)* based on the extended (triangular) shape of the nodes (see Dove/Koch 2011). The number, shape and size

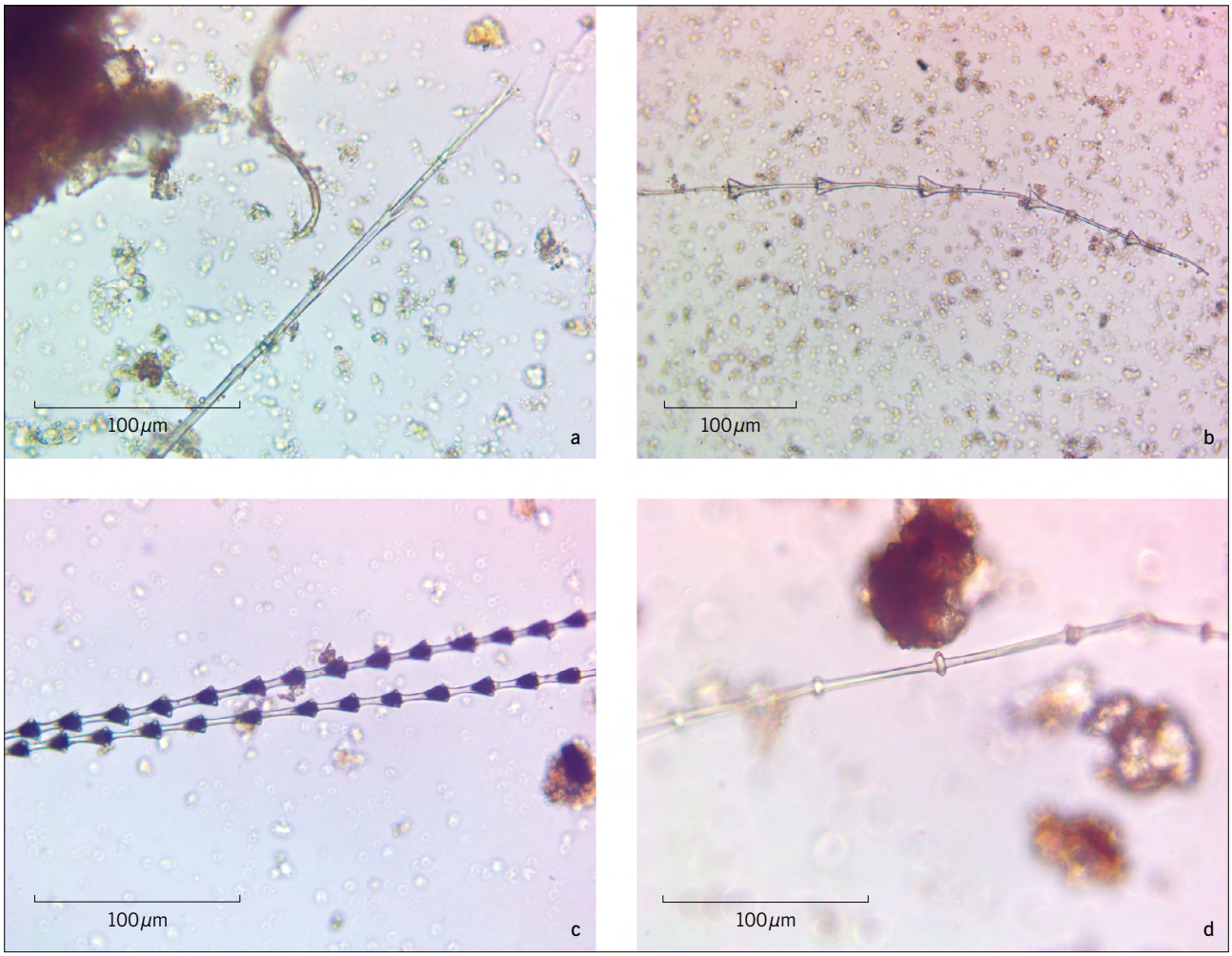


**Fig. 9a–d** Feather fragments detected in the Bad Dürrenberg soil samples. a Unidentified barbule with distal prongs; b waterfowl barbule; c *Passeriformes* (songbirds) barbules; d *Galliformes* sp. barbule.

***Abb. 9a–d*** *Federfragmente, die in den Bodenproben von Bad Dürrenberg gefunden wurden. a Nicht identifizierte Häkchen mit distalen Zinken; b Häkchen von Wasservögeln; c Häkchen von Singvögeln* (Passeriformes)*; d Häkchen von* Galliformes *sp.*

of the nodes, and the distance between the nodes (Fig. 9b) indicate that the find belongs to the family of *Anserinae* (geese) (Dove/Koch 2011).

The two samples from pit feature 15, in which the two above-mentioned antler masks were recovered, revealed four barbules in contact with antler mask 1, i.e. two fragments that were identified by their pigmented nodes as songbirds *(Passeriformes)*; falcons *(Falconidae)* cannot be excluded. An additional barbule fragment with ring-shaped nodes was identified as *Galliformes*, in this case evidently grouse *(Tetraoninae)*. The last of the four barbules provided no diagnostic features for closer identification. The sample taken in contact with antler mask 2 contained no bird-feather fragments but did include one bast fibre. Both the feather fragments found behind the shaman's head and those in contact with antler mask 1 indicate that feathers had been an important part of the headgear or other head decorations. This aligns with the evidence collected from the Skateholm I and II cemeteries.

Finally, although this paper has concentrated on feather finds, the remains of bast fibres and mammalian hairs were also detected. The material had mostly lost its morphological features due to decomposition, so the hairs could not be identified in many cases. The most numerous group of hairs, 15 in total, was comprised of non-medullated guard hairs similar to *Bovidae*, i.e. aurochs *(Bos primigenius)* or bison *(Bison bonasus)*.

## Discussion

The search for microscopic fibres from graves is an issue that has a very short research history. Although furs, textile remains, and feathers have been regularly reported from archaeological contexts (see e.g. Rast-Eicher 2016), separating tiny fibres from sediments has been considered challenging (Rowe 2020, 157). However, it is already clear that the microarchaeological research on fibres is essential if we are to retrieve new information from the distant past.

Based on the research conducted thus far, the wealth of systematic sampling with sufficient sample sizes (100–150 g) cannot be overestimated, as it opens an entirely new door in the reconstruction of burial contexts, costumes and garments. Additionally, the resolution of sampling and the

level of documentation directly affect the possibilities for interpreting the findings. Even at its best, the resulting information is fragmentary, and in order to contextualize the results, both case studies of single burials and analyses of large cemeteries are needed for comparisons. For example, it seems that feathers have been commonly used for headgear or to decorate the head area. Moreover, the use of ethnographic analogies, although not without problems of their own, can offer insights into alternative interpretations. In future, high-resolution sampling with exact documentation in laboratory environments, aided by the most up-to-date scientific imaging technologies, should be tested to gain new information on the use of soft organic materials in burials.

To conclude from the case studies to date, feathers have been an integral part of clothing and grave constructions from the Stone Age onwards. This paper has concentrated on Mesolithic burials; however, there are several examples from burials from later periods, and material has also been collected from settlement sites. Furthermore, downy feathers are familiar even in present-day burials when used to fill the pillow placed under the deceased's head.

## Acknowledgements

I thank Professor Lars Larsson and the University of Lund for Skateholm I and II soil samples, and Professor Harald Meller and his team of the State Office for Heritage Management and Archaeology Saxony-Anhalt, State Museum of Prehistory, for the research material from the Bad Dürrenberg shaman burial. I also thank the Finnish Heritage Agency for the Majoonsuo soil samples. My gratitude goes to Lars Larsson, Franziska Knoll, and Kristiina Mannermaa who kindly read the manuscript and gave their valuable comments. Finally, I thank my husband Teo Kirkinen for helping with the figures. I also thank the editorial team of this volume for their valuable help in improving the text.

This research is financed by the Animals Make Identities. The Social Bioarchaeology of Late Mesolithic and Early Neolithic Cemeteries in North-East Europe (AMI) project that has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 864358).

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# Twining things together: how functional approaches can help to understand the processing of fibres in the Palaeolithic

Veerle Rots and Sonja Tomasso

**Zusammenfassung**

Dinge miteinander verflechten: wie funktionale Ansätze helfen können, die Verarbeitung von Fasern im Paläolithikum zu verstehen

*Obwohl pflanzliche Fasertechnologien im prähistorischen Lebensalltag wahrscheinlich von entscheidender Bedeutung waren, insbesondere für die Herstellung von Bindungen, Schnüren und Textilien, sind sie wegen des schlechten Erhaltungsgrades nur unzureichend dokumentiert. Die vorliegende Studie ist ein erster Schritt zur Überbrückung dieser Lücke, indem sie die Faserverarbeitung mithilfe detaillierter experimenteller Versuche und systematischer Auswertung der mikroskopischen Gebrauchsspuren an Steinwerkzeugen untersucht. Damit wollen wir die archäologische Nachweisbarkeit solcher Aktivitäten erleichtern, auch wenn kein organisches Material erhalten ist. Wir konzentrieren uns auf eine Vielzahl von Pflanzenarten aus Feuchtgebieten, die für die Faserverarbeitung relevant sind, und berichten über die kontrollierten Experimente, die mit Steinwerkzeugen durchgeführt wurden. Wir diskutieren die Verschleißentwicklung und beleuchten, inwiefern Pflanzeneigenschaften wie Mineralgehalt und Härte zu diesem Prozess beigetragen haben könnten. Wir kommen zu dem Schluss, dass funktionelle Studien nützliche Erkenntnisse liefern können, um das Verständnis der Faserverarbeitung bei paläolithischen Völkern zu verbessern.*

**Schlagwörter** Gebrauchsspuren, Rückstände, Fasertechnologie, experimentelle Archäologie, Paläolithikum

**Summary**

*Although plant-based fibre technologies were likely crucial in prehistoric life, especially for making bindings, cordage, and textiles, they remain poorly documented due to preservation issues. This study is a first step in bridging that gap by exploring fibre processing through detailed experimental work with systematic evaluation of the microscopic use-wear traces that develop on stone tools. As such, we aim to improve the archaeological recognition of such activities even when no organic material is preserved. We focus on a variety of wetland plant species relevant to fibre processing and report on controlled experiments conducted using stone tools. We discuss the wear formation and focus on how plant properties such as mineral content and hardness may have contributed to this process. We conclude that functional studies may provide useful insight to improve the understanding of fibre processing among Palaeolithic populations.*

**Keywords** Use-wear, residues, fibre technology, experimental archaeology, Palaeolithic

## Introduction

To manufacture clothing, Stone Age people could exploit both animal resources (e.g. hides, furs) and plant materials (e.g. fibres). Direct evidence for clothing is exceptionally rare due to the poor preservation chances of organic materials such as hides, fibres and textiles. Therefore, use-wear traces on stone tools are an important means of investigating when relevant raw materials were processed and whether the way in which these materials were processed reveals something about their possible role in the manufacture of clothing. For instance, preserved animal hides are virtually absent for the Palaeolithic period, but use-wear traces on stone tools indicate that hide-working activities predate the Upper Palaeolithic, with examples dating back to the early Middle Palaeolithic[1]. By contrast, signs of elaborate processing of animal hides (which suggest a use in clothing) only start to appear from the Upper Palaeolithic period onwards (Beyries/Rots 2008a; Beyries/Rots 2008b; Aleo et al. 2021). Similarly, we must reflect on the extent to which use-wear traces on stone tools can be helpful to infer the use of vegetal materials in clothing. A first step is to investigate how

1 E.g. Keeley 1980; Claud 2015; Rots et al. 2015; Venditti et al. 2022.

we can identify fibre processing, one of the so-called »invisible technologies« (Hurcombe 2014). Fibres are the basis for all clothing made from vegetal materials, but also for many other products (such as cordage) that are crucial in the daily lives of prehistoric hunter-gatherers. The ability to extract, process, and manipulate plant fibres into twine (and subsequently into ropes or textiles) represents a technological milestone in human evolution with important implications for tool hafting (Rots 2003), rope manufacture (Conard/Rots 2024) and associated aspects (e.g. transport, bags), subsistence (e.g. fishing nets), shelter construction, and, in addition, related technologies such as basketry (Hurcombe 2014). It is therefore fundamental to explore how functional studies can help to understand the invention and development of fibre-based technologies in the Palaeolithic.

Studying fibre-based technologies is methodologically complex, and furthermore, terminologies are not yet truly standardised. Attention has focused primarily on flax and wool textiles, and somewhat less on bast or leaf fibres and cordage. The main reason is that woven textiles are generally better preserved in burial contexts and wet environments, whereas materials such as cordage and basketry degrade more easily and are often only detected through indirect evidence, such as impressions in clay (Adovasio et al. 1999).

The definition of a ›textile‹ varies among researchers, with some scholars restricting the term to woven fabrics (e.g. Emery 1966), whereas others adopt a broader classification that includes perishable materials such as netting, twined fabrics, and even certain types of basketry (Harris 2014; Banck-Burgess et al. 2023). This hampers regional and chronological comparisons. Several initiatives have nevertheless been taken to move towards more standardised definitions, especially for wetland and arid environments where the chances of preservation are higher. Such studies have contributed to the establishment of a broader and more inclusive framework that recognises the diversity of fibre-based technologies beyond what may or may not be classified as a textile (Good 2001; Hurcombe 2014).

In this paper, we review existing evidence for plant processing, with a particular focus on fibre technology and ropemaking, since we regard these as precursor technologies to the production of textiles from plants. We address the main methodological challenges in studying these technologies from the perspective of a functional analysis of stone tools. We include the identification of fibre-processing tools, the limitations imposed by the lack of organic preservation, and the difficulties in distinguishing natural from anthropogenic fibre modifications. We also discuss how we have tried to overcome some of these challenges in recent experimental work. We do not address clothing production from animal products, since the technological trajectories are totally different, with hide processing being more readily identifiable through stone tool use-wear analysis (e.g. Rots/Williamson 2004; Beyries/Rots 2008a; Beyries/Rots 2008b).

*Research Context*

Vegetal resources have been exploited for technological purposes from early on, as illustrated by some exceptional finds, such as the unique wooden structural elements dating to 476 000 years ago recently recovered at Kalambo Falls, Zambia (Barham et al. 2023), which are the oldest examples to date, or the surprisingly rich set of wooden tools recovered from the 200 000- to 300 000-year-old site of Schöningen, Helmstedt District, Germany[2]. Also, other examples testify to the importance of the exploitation of vegetal resources[3]; these only provide a glimpse of the likely much broader range of wooden implements used by prehistoric hunter-gatherers.

While little direct evidence is preserved, cordage must also have played a crucial role for prehistoric people, not least for making all kinds of implements (e.g. stone tool hafting) or in construction (such as the tying of shelters or wooden structures). Indirect evidence for binding technology exists from as early as ~ 250 000 years ago in Europe (Rots 2013) and ~ 200 000 years ago in Africa (Rots/Van Peer 2006) and consists of wear traces demonstrating the use of bindings in stone tool hafting, even if the nature of the materials (animal or plant) remains unidentified. A more direct trace of the binding itself comes from the Middle Stone Age site of Ifri n'Ammar, Nador Province, Morocco, where one of the projectiles showed hafting wear in association with a ferruginised residual deposit that could be interpreted as the fossilised remains of a vegetal binding, thereby confirming the exploitation of plant fibres in connection with hafting during this period (Fig. 1; Tomasso 2024). Nevertheless, early evidence for rope or cordage remains is scarce and often disputed. A well-known example is the so-called »twisted fibre« from Abri du Maras, Dép. Ardèche, France (~ 46 ka), proposed as early evidence for cord making among Neanderthals (Hardy et al. 2020); this, however, is an interpretation we seriously question for multiple reasons. As shown in the published images, the fibre is clearly deposited on top of sediment, which suggests that it may represent contamination, and its singular nature does not convincingly support intentional twisting or deliberate use in cord making. The twist that can be observed represents a natural twist of a single fibre and does not show the combination of different strands of fibres in a Z- or S-twist to make string. Similarly, the twisted fibres reported from Ohalo II, Sea of Galilee, Israel (~ 19 ka) have not been conclusively identified as cordage (Nadel et al. 1994). After all, fibres are ubiquitous in prehistoric environments, and their adherence to artefacts or their presence in the sediments may result from natural processes. Detailed analysis is therefore required to demonstrate that the presence of fibres is due to an intentional process, ideally combined with clear signs of their manipulation or processing. The mere presence of a fibre, even if it may appear twisted, is therefore not sufficient evidence to argue for cordage.

2 Thieme 1997; Schoch et al. 2015; Conard et al. 2020; Conard/Rots 2024; Milks et al. 2023; Leder et al. 2024; Hutson et al. 2025.

3 E.g. Oakley et al. 1977; Thieme et al. 1985; Aranguren et al. 2018; Florindi et al. 2024; Carbonell/Castro-Curel 1992; Erič et al. 2018.

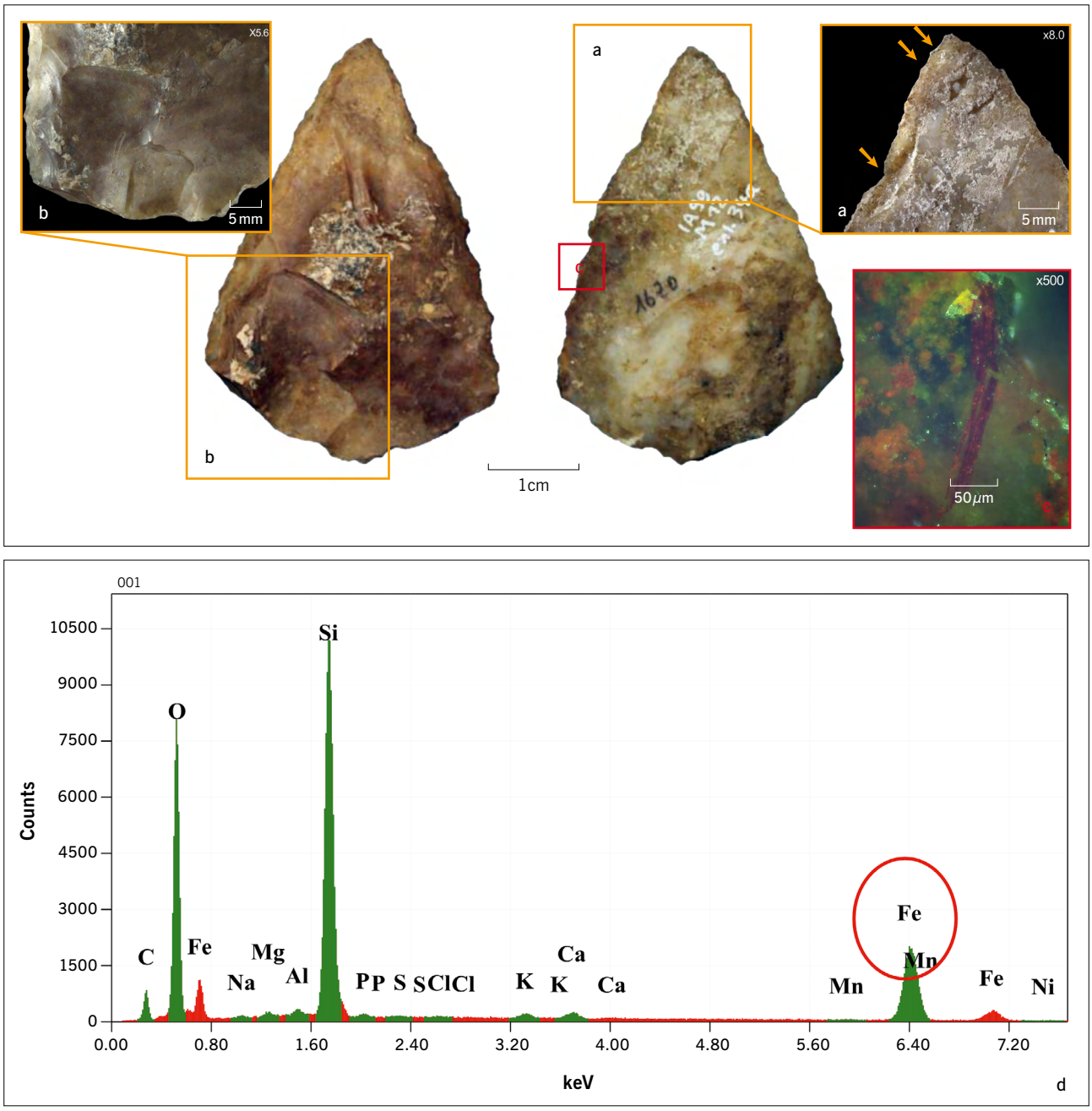


**Fig. 1a–d** Evidence of vegetal binding on a Middle Stone Age projectile from Ifri n'Ammar (Morocco); a macroscopic detail of the distal damage of the point, showing the bending-initiated scars with step-hinged and step-fissured terminations on the ventral face, all oriented in the same direction (x 8.0); b macroscopic detail of the possible intentional thinning on the proximal extremity with step-terminating scars on the dorsal face (x 5.6); c microscopic detail of the elongated ferruginised residue, under polarised light (x 500) and electron image detail of the same residue (x 400); d elemental spectrum of the ferruginised residue showing the significant peak of iron (Fe).

***Abb. 1a–d*** *Nachweise für pflanzliche Umwicklung (Befestigung) an einem Projektil auf einem Middle Stone Age Projektil aus Ifri n'Ammar (Marokko). a Makroskopisches Detail der distalen Beschädigung der Spitze, mit den durch die Biegung entstandenen Negativen mit stufenförmig gelagerten und stufenförmig gesprungenen Enden auf der ventralen Seite, die alle in dieselbe Richtung weisen (x 8.0); b makroskopisches Detail der möglichen absichtlichen Verschlankung am proximalen Ende mit stufenförmig Enden der Abschlagsnegative auf der dorsalen Seite (x 5,6); c mikroskopisches Detail der länglichen ferruginisierten Residuen unter polarisiertem Licht (x 500) und Elektronenbilddetail desselben Rückstands (x 400); d Elementarspektrum der ferruginisierten Residuen, das ein signifikanten Peak von Eisen (Fe) zeigt.*

Early examples of fibre use, therefore, remain highly debated; however, more secure evidence is available for the later Upper Palaeolithic. Among the earliest direct examples of ropemaking in western Europe is a fossilised rope fragment made of twisted plant fibres from Lascaux, Dép. Dordogne, France, dated to approximately ~ 20 500 cal BP (Leroi-Gourhan 1982). Similarly, multiple interlaced or braided plant fibres from Santa Maira, Valencia Province, Spain, dated to 12 730–12 710 cal BP, represent the oldest directly dated evidence for the use of braided plant fibres in Europe (Aura Tortosa et al. 2020). Furthermore, exceptional preservation at sites like Nahal Hemar, near Mount Sodom, Israel, has revealed fragments of baskets, cords, linen yarns, and fabrics, demonstrating the technological complexity

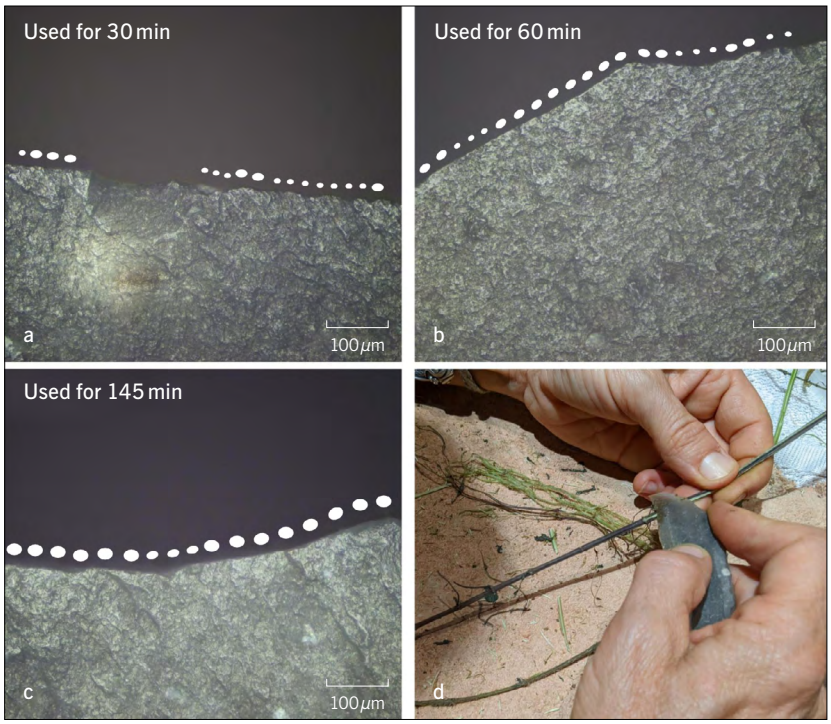


**Fig. 2a–d** Experimental fibre processing on fresh nettle stems illustrating the gradual development of wear patterns, with a) microscopic detail of the used edge of the experimental tool Exp110/106 after scraping nettle stems for 30 minutes, showing initial wear formation (× 200); b after 60 minutes of use, wear patterns remain weak with no significant change in development on the used edge of the tool Exp110/108 (× 200); c after 145 minutes, the edge exhibits slightly more pronounced rounding and polish, indicating progressive wear accumulation Exp 110/108 (× 200).

***Abb. 2a–d*** *Experimentelle Faserverarbeitung an frischen Brennnesselstängeln, die die allmähliche Entwicklung von Abnutzungsspuren veranschaulicht. a mikroskopisches Detail der verwendeten Kante des Versuchswerkzeugs Exp110/106 nach dem Schaben von Brennnesselstängeln für 30 Minuten, das die anfangende Verschleißbildung zeigt (× 200); b nach 60 Minuten Gebrauch bleiben die Abnutzungsspuren schwach, ohne signifikante Verschleißentwicklung an der verwendeten Kante des Werkzeugs Exp110/108 (× 200); c nach 145 Minuten zeigt die Kante eine etwas ausgeprägtere Abrundung und Politur, was auf eine fortschreitende Gebrauchsspurenbildung hinweist Exp 110/108 (× 200).*

and cultural significance of fibre use in the Neolithic Southern Levant (Shamir 2020).

More evidence is available for the beginning of the Holocene, probably because of improved general preservation conditions and a greater availability of fibre-producing plants, thanks to the spread of forests across northern and central Europe. Illustrative examples include a willow bast fishing net from Antrea (now Kamennogorsk) Leningrad Oblast, Russia (~ 8500–8200 cal BP; Carpelan 2008), plaited cords and net fragments from Friesack, Havelland District, Germany (~ 9100–7800 cal BP; Gramsch 1992), and needle-netted textiles from the submerged site of Tybrind Vig, Funen, Denmark (~ 7400–6000 cal BP; Andersen 2013). These finds illustrate both the technical sophistication and the deep-rooted tradition of fibre working among Mesolithic communities.

## Plant fibres and challenges in tracking Palaeolithic fibre working

Plant fibres are naturally derived from vascular plants (tracheophytes; Evert 2006), which have evolved specialised tissues providing structural support and flexibility. Their primary components, cellulose and lignin, determine their strength, durability, and elasticity, making them suitable for a wide range of technological applications. From a craft and technological perspective, plant fibres can be classified into hard and soft fibres, based on their physical, technical, and chemical properties. Plant fibres are categorised as hard fibres when they are extracted from monocotyledonous plant leaves and sedge stems. Such fibres are mainly used for cordage and basketry (Herrero Otal 2024). Soft fibres or bast fibres are extracted from the stalks of dicotyledonous plants like flax, hemp, and nettle. Such fibres require more intensive processing but are primarily used for textile production.

## What tools were used to manufacture and process fibres?

A key challenge in understanding fibre processing in the Palaeolithic is that it did not necessarily require the use of stone tools, as also shown by ethnographic observations and experiments. Fibres can be processed without tools, or with perishable organic tools such as wood, bone, or antler. Traditional societies commonly use wooden smoothers, weaving sticks, or spindles, all of which leave little to no archaeological traces. However, the use of grinding stones to pound or beat fibres to detach and soften them has been documented ethnographically, for example, in the case of Triodia grass *(Spinifex)* among Australian indigenous populations (Hayes et al. 2018). This implies that such applications could be visible archaeologically and identifiable through a combination of residue and use-wear analysis.

Even though direct evidence for organic tools is scarce, a few remarkable examples do exist. A notable case is a four-holed ivory artefact from the Aurignacian layers of Hohle Fels, Alb-Donau District, Germany, interpreted as a rope-making tool based on an integrated approach that includes wear and residue analysis, as well as experiments (Conard/Rots 2024). Other Upper Palaeolithic sites have also yielded relevant objects, including possible battens made from mammoth ribs and ivory, weaving sticks crafted from bird and mammal bones, as well as net gauges and spindles bearing use-wear patterns suggestive of textile or net-making activities (Soffer 2004). Bone needles are, of course, among the most convincing and recognisable tools associated with

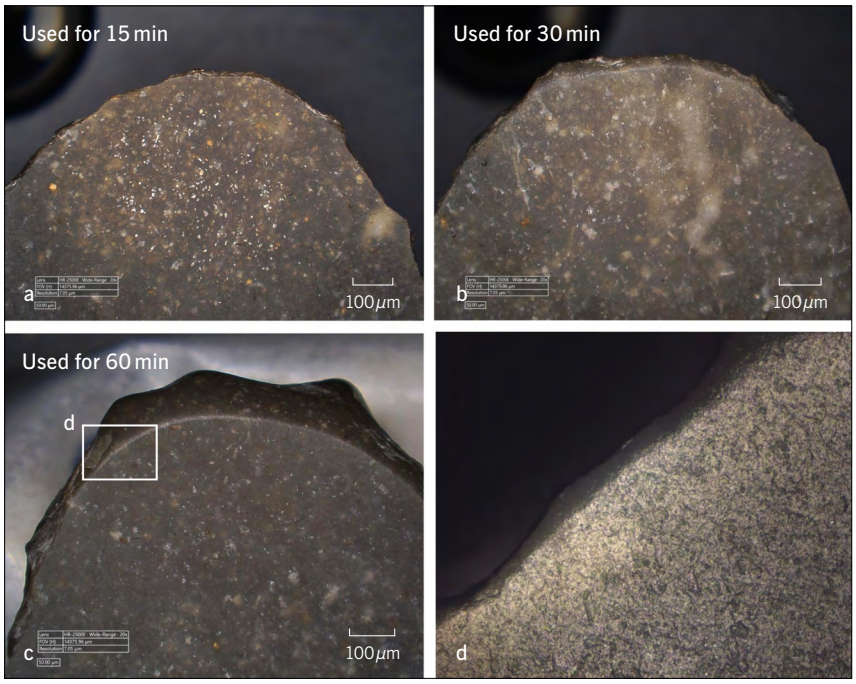


**Fig. 3a–d** Experimental scrapers used to scrape dry hide, illustrating the gradual development of wear patterns, with a) macroscopic detail of the used edge of the experimental tool Exp 56/21 after scraping dry hide for 15 minutes, showing initial edge rounding (×20); b after 30 minutes of use, a more pronounced edge rounding is visible on the scraper head Exp 56/23 (× 20); c after 60 minutes, the edge exhibits a very pronounced rounding, indicating progressive wear accumulation Exp 56/26 (× 20); d microscopic detail of the pronounced edge rounding of the experimental tool Exp 56/26 (× 200).

***Abb. 3a–d*** *Experimentelle Schaber zum Schaben von trockener Tierhaut, die die allmähliche Herausbildung von Abnutzungsspuren veranschaulichen. a Makroskopisches Detail der verwendeten Kante des experimentellen Werkzeugs Exp 56/21 nach 15 Minuten Schaben von trockener Tierhaut, das eine beginnende Kantenabrundung zeigt (× 20); b nach 30 Minuten Gebrauch ist eine ausgeprägtere Kantenabrundung am Schaberkopf Exp 56/23 sichtbar (× 20); c nach 60 Minuten weist die Kante eine sehr ausgeprägte Abrundung auf, was auf eine fortschreitende Verschleißbildung hinweist Exp 56/26 (× 20); d mikroskopisches Detail der ausgeprägten Kantenabrundung des Versuchswerkzeugs Exp 56/26 (× 200).*

fibre working and textiles or leather. Eyed needles appear from ~ 40 000 cal BP in Siberia, ~ 38,000 cal BP in the Caucasus, ~ 30 000 cal BP in East Asia, and by 26 000 cal BP in Europe (d'Errico et al. 2018; Gilligan et al. 2024). Numerous bone needles were recovered for Gravettian, Solutrean, and Magdalenian contexts; these often show eyelets, which typically associate them with sewing, although use in net-making, basketry, and fish-trap construction must also be considered (Cheval 2023). Evidence is clearly more abundant from the Mesolithic period onwards, such as a Mesolithic spatula-like tool made from a swan's ulna found at De Bruin, in Hardinxveld-Giessendam (South Holland Province, the Netherlands): it is decorated and perforated at one end. It shows use-wear consistent with fibre processing, such as plaiting or net-weaving, and experimental replication has confirmed its effectiveness (Van Gijn 2005). Noteworthy are also the bone awls found at the Middle Neolithic site of Schipluiden, South Holland Province, the Netherlands, on which microwear traces were observed that suggest their use in basket-making, possibly to secure willow bark fibres within a woven structure (Van Gijn 2008).

Altogether, these finds highlight the significant role of organic tools in fibre-processing technologies, yet their archaeological visibility remains limited due to preservation issues. Detailed analysis of flaked stone tools or stone implements alone will thus, by definition, underestimate the importance of fibre working and provide a partial view only. Moreover, even when stone tools are employed, it should be mentioned that fibre working places few demands on tool morphology or raw material, with simple blanks or waste products being perfectly suitable. This implies that they will only be detected archaeologically if the material selections for functional studies take this factor into account.

## Complexity of wear formation on stone tools

When stone tools are used for fibre processing, we can observe that the wear traces tend to form slowly and that traces often remain subtle, even after extensive use (Fig. 2). This contrasts sharply with dry hide processing, for instance, which produces very recognisable wear traces after a relatively short use (Fig. 3).

In addition, many variables influence the formation of wear traces in the case of fibre or plant processing. Firstly, moisture content plays a major role: plants collected during spring or from humid environments tend to produce better-developed polishes[4]. Secondly, factors such as the specific plant species worked, the season of harvesting, the nature of the task (e.g. stripping, softening, twining), and the use duration all play a role and may influence the characteristics and diagnostic aspect of the traces[5]. Wear formation is thus complex, and among all intervening variables, the plant species composition deserves special attention, since we note that differences in the biomineral content between plant species and different parts of the same plant introduce an additional layer of complexity (Tomasso et al. 2024).

4 Anderson-Gerfaud 1981; Astruc et al. 2003; Fullagar 1991; Hayden/Kamminga 1973; Ibáñez/Mazzucco 2021; Keeley 1980; Mazzucco et al. 2022; Unger-Hamilton 1983.

5 Evans et al. 2014; Gassin et al. 2013; Jensen 1994; Vaughan 1985.

6 Anderson-Gerfaud 1981; Fullagar 1991; Jensen 1994; Keeley/Newcomer 1977; Van Gijn 1990.

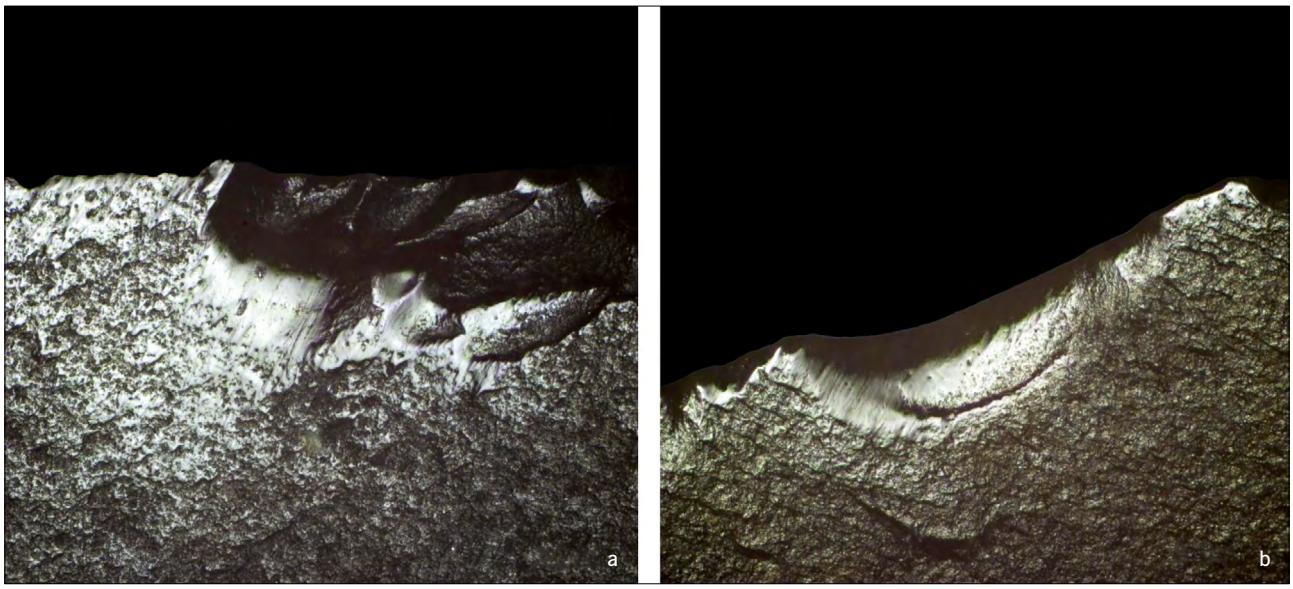


**Fig. 4a–b** Microscopic use-wear evidence of plant-working on Mesolithic flint artefacts from Beveren, East Flanders, Belgium; a–b detail of edge scarring combined with additional abrasion on the tool's working edge (× 200). These wear patterns align with previous observations from Northwest European Mesolithic contexts but exemplify the ongoing challenge of linking specific microwear traces to particular plant species or tasks.

***Abb. 4a–b*** *Mikroskopische Gebrauchsspuren von Pflanzenbearbeitung an mesolithischen Feuersteinartefakten aus Beveren, Ostflandern, Belgien; a–b Detail der Kantenvernarbung in Kombination mit zusätzlichem Abrieb an der Arbeitskante des Werkzeugs (× 200). Diese Abnutzungsmuster stimmen mit früheren Beobachtungen aus nordwesteuropäischen mesolithischen Kontexten überein, sind aber ein Beispiel für die anhaltende Herausforderung, spezifische Mikroabnutzungsspuren mit bestimmten Pflanzenarten oder Aktivitäten in Verbindung zu bringen.*

## Diversity in plant species composition

A broad range of plant species is available for fibre production, and each species differs in its biomineral composition, which may affect wear formation on stone tools. The effect of silica, present as phytoliths, has been most extensively studied and is known for its abrasive characteristics[6]. The silica content varies widely between species, with high-silica plants, such as *Equisetum* and wetland grasses, producing stronger polish than low-silica species, like legumes (Jensen 1994). While these differences can present advantages for distinguishing among processed plants, it remains very challenging on the basis of wear traces alone and generally requires the integration of residue analysis (Pearsall 1994; Piperno 2006; Raven 1983).

Other biominerals, such as calcium oxalates, are comparatively underexplored (but see Tomasso et al. 2024), and more comprehensive experiments are needed to systematically evaluate the impact of a broad spectrum of plant properties. Early experimental work has mostly focused on wear formation for the general category of plants or specific cases like sickle gloss[7], while more recent studies have expanded towards a more detailed understanding of cereal harvesting (Anderson 1999; Ibáñez et al. 2008; Mazzucco et al. 2016), fibre production (Caspar et al. 2007; Hurcombe 1994), and the relationship between tool form and plant processing[8].

However, it remains an important challenge that many experiments involve small sample sizes and do not always document variables like plant part worked, species, working environment, and harvesting season in sufficient detail. The reference framework, therefore, remains fragmented, which complicates archaeological interpretations[9]. Experiments with long use durations remain rare, with cereal processing as a notable exception[10]. Given the importance of long usage for diagnostic wear to form and the possibility of equifinality between certain activities, the reference framework urgently needs to be elaborated upon.

## Ambiguities in plant polish formation on stone tools

Identifying plant-working activities based on microwear traces remains a challenge[11]. Several Final Palaeolithic and Mesolithic flint artefacts from sites across Northwest Europe, including regions such as Denmark, Britain, and France, have been shown to exhibit distinctive smooth, bright polishes that are typically attributed to the processing of siliceous plant fibres[12]. However, the specific plant species or the nature of the activity remain uncertain because the variation in polish formation is still insufficiently documented, making it difficult to establish a reliable link between specific use-wear traces and a particular (range of) task(s) (Fig. 4).

7 Anderson 1980; Curwen 1930; Curwen 1935; Fullagar 1991; Gassin 1994.
8 Beugnier/Crombé 2007; Gassin 1994; Guéret et al. 2014; Osipowicz 2019; Sobkowiak-Tabaka/Kufel-Diakowska 2019; Little/Van Gijn 2017.
9 Beugnier/Crombé 2005; Gassin et al. 2013; Little/Van Gijn 2017; Sobkowiak-Tabaka/Kufel-Diakowska 2019.
10 Anderson-Gerfaud 1992; Ibáñez/Mazzucco 2021; Mazzucco et al. 2022; Van Gijn 1990.
11 E.g. Little/Van Gjin 2017, Osipowicz 2019; Sobkowiak-Tabaka/Kufel-Diakowska 2019.
12 Jensen 1994; Hurcombe 2008; Gassin et al. 2013; Guéret 2013; Little/Van Gijn 2017.

**Fig. 5a–d** Examples of plant-working experiments: a scutching dry flax; b scraping bark of a hazelnut branch *(Corylus avellana)*; c cutting a branch bark of *Salix alba*; d cutting a branch of *Salix alba*.

***Abb. 5a–d*** *Beispiele für Pflanzenbearbeitungsexperimente: a Hecheln von trockenem Flachs; b Abschaben der Rinde eines Haselnusszweiges* (Corylus avellana)*; c Schneiden der Zweigrinde von* Salix alba*; d Schneiden eines Zweiges von* Salix alba.

Another illustrative example of this complexity is what has been termed ›Polish 23‹, a well-known but poorly understood polish type. Recognised from early on in use-wear studies (e.g. Caspar et al. 2005), it is characterised by a combination of features suggestive of both plant and animal contact. Indeed, one surface generally exhibits wear traces reminiscent of hide-working, including edge rounding associated with a rough and dull polish, and striations perpendicular to the edge, whereas the opposite surface shows a bright, smooth polish that is reminiscent of plant-working. Reproducing this double characteristic experimentally has been challenging. This Polish 23 is nevertheless well-documented from the Final Palaeolithic onwards while appearing relatively frequently in early Neolithic assemblages (Caspar et al. 2005). A possible link with flax fibre processing was proposed on the basis of a range of experimental studies[13], but these interpretations have never been entirely satisfactory because the exact wear characteristics have remained difficult to reproduce. This is likely due to insufficient knowledge regarding the impact of variables such as plant species, plant condition (fresh, soaked, or dry), and the use of additives.

## Possibilities in terms of methodological approach: rationale

Building on the efforts of other researchers, we have tried to advance the understanding of fibre processing on the basis of an integrated approach that combines substantial experimental work, detailed wear and residue analysis, a botanical reference library, and an analysis of the biomineral composition of the plants (see also Tomasso et al. 2024). We hope that such an approach will improve insight into the formation process of wear traces and how this process is impacted by varying plant compositions. We observe that the abundance of silica minerals and/or calcium oxalates differs between plant species, but also between different parts of one and the same plant, which emphasises the importance of the biomineral composition of the plant (parts) for adequately understanding use-wear formation (Tomasso et al. 2024) and artisanal activities. A more systematic integration of residue analysis is also important, as the recovery of residual plant fragments on the stone tool surfaces may help to identify the plant species. At the same time, experimental programs need to cover the broad range of possible artisanal plant working tasks and include sufficiently long and realistic use durations to guarantee a better understanding of the wear formation process and possible equifinality between activities or plant species. The resulting reference framework will be more robust and serve as a more reliable reference against which archaeological assemblages can be compared.

## Results from recent experiments and functional analyses

Recently, we have invested efforts in developing a large-scale experimental program within the rationale presented above, and we include some results from the first phase of this programme here. We emphasise that this initial phase was exploratory in nature and aimed to enhance our knowledge of plant wear formation when processing wetland plants (for more details, see Tomasso et al. 2024). The programme included the creation of a reference collection of plants available in Northwestern European wetland ecosys-

13 E.g. Caspar et al. 2005; Beugnier/Crombé 2005; Beugnier/Crombé 2007; Osipowicz 2019.

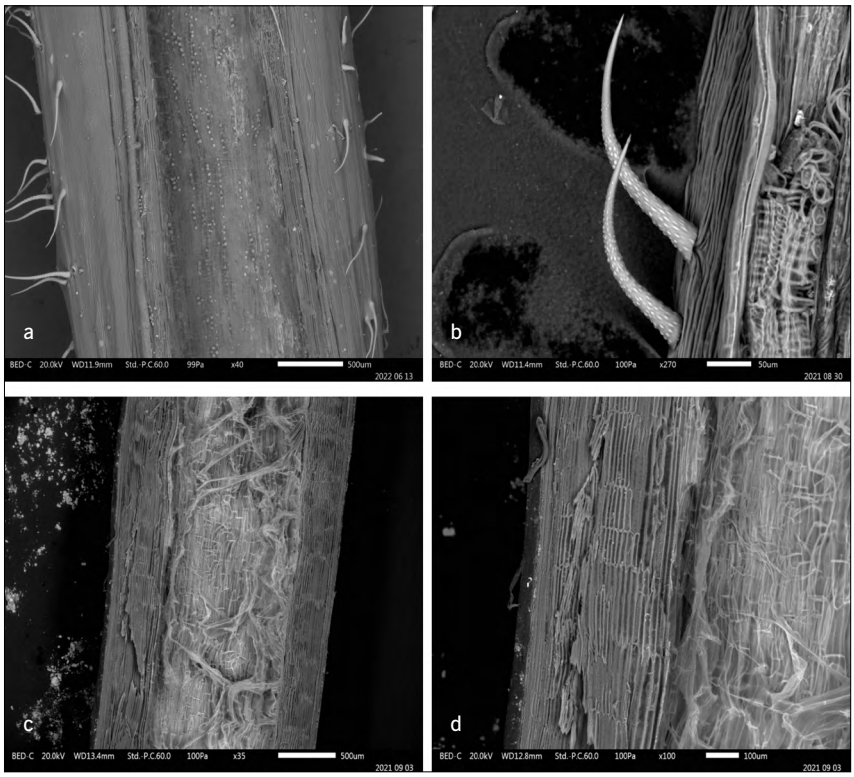


**Fig. 6a–d** SEM-EDS analysis of botanical samples: a–b silica minerals present in the trichomes of nettle *(Urtica dioica)*; c–d virtual absence of biominerals present in the stem of flax *(Linum usitatissimum)*.

***Abb. 6a–d*** *REM-EDS-Analyse botanischer Proben: a–b Kieselsäuremineralien in den Trichomen der Großen Brennnessel* (Urtica dioica)*; c–d weitgehende Abwesenheit von Biomineralien im Stengel des Flachses* (Linum usitatissimum).

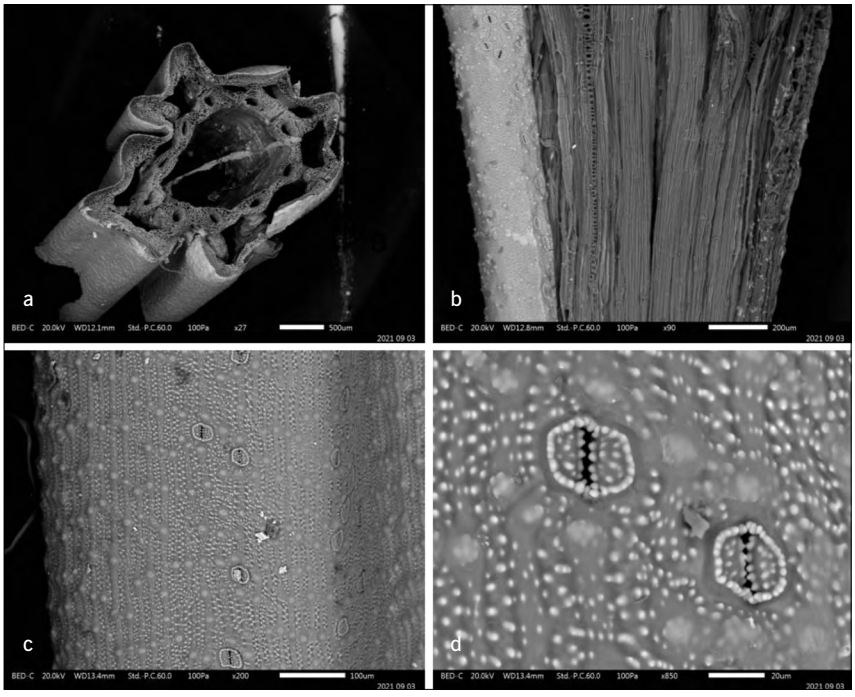


**Fig. 7a–d** SEM-EDS analysis of botanical samples, showing the high amount of silica located on the epidermal surface of horsetail *(Equisetum telmateia)*, with a) detail of the transversal section of the stem and; b–d the longitudinal section of the same part of the stem.

***Abb. 7a–d*** *REM-EDS-Analyse botanischer Proben, die den hohen Anteil an Kieselsäure auf der epidermalen Oberfläche des Schachtelhalms* (Equisetum telmateia) *zeigt, mit a) Detail des Querschnitts des Stängels und; b–d Längsschnitt desselben Teils des Stängels.*

tems and a set of plant processing experiments (Fig. 5) to improve our understanding of plant wear formation within a controlled setting. We specifically sought to explore the impact of the biomineral composition of the plants (Fig. 6–8; i.e. silica and calcium oxalates) on wear trace formation and to contribute to a more comprehensive reference framework to facilitate the identification of plant-related wear traces in archaeological contexts. Attention was also devoted to the influence of use duration and working angle.

The result is a reference collection of tools used to process 15 wetland plant species (Tab. 1) for durations of up to 265 minutes and with consistent motions to process and clean plant parts (Tomasso et al. 2024). For each of these, we systematically tested how differences in silica and calcium oxalate content affect the wear formation process.

Tools were analysed for wear patterns using multiple microscopic techniques, including optical microscopy (stereomicroscopes, metallurgical microscopes) and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS). Wear attributes such as polish distribution, topography, and edge damage were systematically documented, and hierarchical clustering analy-

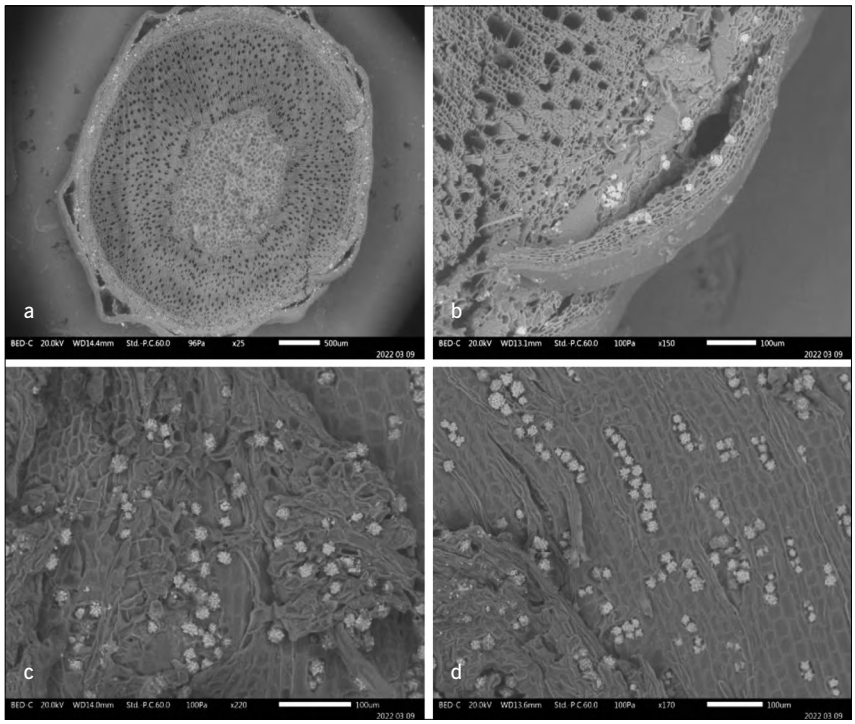


**Fig. 8a–d** Location of calcium oxalate crystals shown in a–b (transversal section) in the epidermis of willow *(Salix alba)*; c–d longitudinal section showing a detail of the calcium oxalate crystals with a druse morphology.

***Abb. 8a–d*** *Lage der Kalziumoxalatkristalle in a und b (Querschnitt) in der Epidermis der Weide* (Salix alba)*; c–d Längsschnitt, der ein Detail der Kalziumoxalatkristalle mit einer Drusenmorphologie zeigt.*

**Tab. 1** Overview of the 15 wetland plant species used in the first phase of the experiment.

***Tab. 1*** *Übersicht über die 15 Feuchtgebietspflanzenarten, die in der ersten Phase des Experiments verwendet wurden.*

| Plant species | Family | Plant part | Calcium oxalate (CO) | Silica (Si) |
|---|---|---|---|---|
| *Equisetum Arvense* | Horsetail | stem | absent | present |
| *Equisetum Telmateia* | Horsetail | branch | absent | present |
| *Dryopteris Filix-Mas* | Male Fern | stem | absent | absent |
| *Typha latifolia* | Bulrush | leaf | present | absent |
| | | stem | absent | present |
| *Phalaris arundinacea* | Reed canary grass | leaf | absent | present |
| | | stem | absent | present |
| *Urtica dioica* | Stinging nettle | stem | present | present |
| *Dactylis glomerata* | Cock‘s-foot | stem | absent | present |
| *Rubus (fruticosus)* | Blackberry | stem | present | absent |
| *Corylus (avellana)* | Common hazel | branch | present | absent |
| *Alnus (glutinosa)* | Black alder | branch | present | absent |
| *Tilia cordata* | Small-leaved lime | branch | present | absent |
| *Quercus cerris* | Turkey Oak | branch | present | absent |
| *Salix alba* | White willow | branch | present | absent |
| *Ulmus* sp. | Elm | branch | present | absent |
| *Betula* | Birch | bark | present | absent |

sis was employed to identify patterns in wear variability (see Tomasso et al. 2024 for more details). We were able to demonstrate that differences in polish formation are primarily explained by the significant difference in hardness between silica and calcium oxalate crystals, with plant silica being up to 170 times harder. Secondly, silica density and overall material hardness appear to influence the degree of abrasion, regardless of whether the plant is herbaceous or woody. Moreover, use duration proves to play a secondary role in polish development when processing wetland plants compared to the biochemical and physical properties of the plant itself. Knowledge of the plant properties is thus essential for a reliable reference to be used when examining archaeological tools for evidence of plant processing.

This initial phase of the experimental program highlighted the multifaceted nature of plant wear formation and the influence of variables related to the plant and the activity. It provides a good basis for the continued development of existing references to consolidate archaeological interpretations.

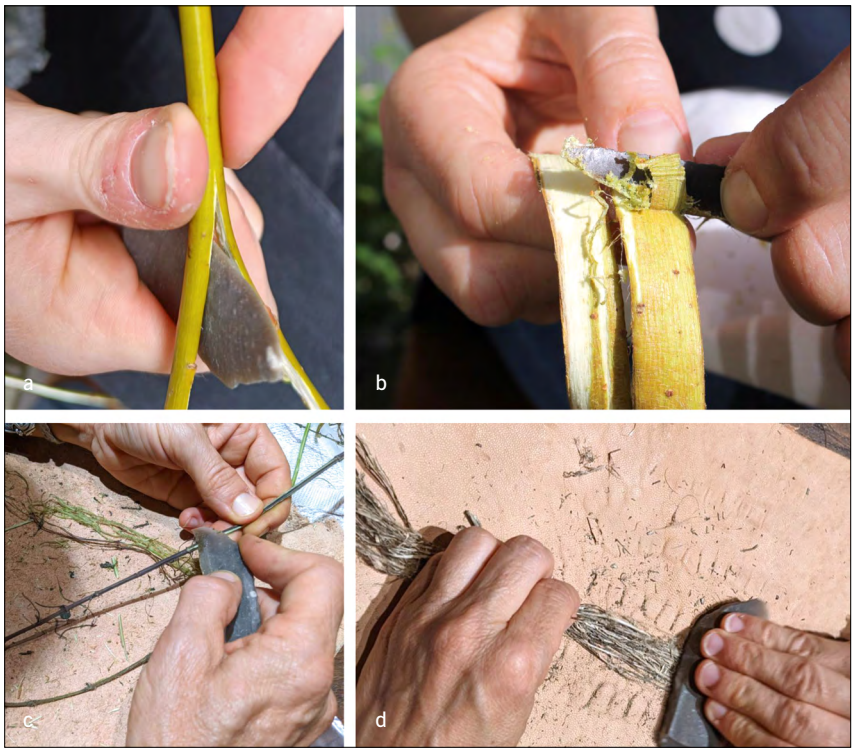


**Fig. 9a–d** Experimental tools used in fibre processing. This subset of experiments focused on scutching, breaking, and scraping plant stems to extract fibres: a splitting willow *(Salix alba)*; b cleaning the cambium of willow *(Salix alba)*; c–d scraping nettle *(Urtica dioica)*.

***Abb. 9a–d*** *Experimentelle Werkzeuge, die bei der Verarbeitung der Fasern verwendet wurden. Diese Untergruppe von Experimenten konzentrierte sich auf das Hecheln, Brechen und Schaben von Pflanzenstängeln zur Gewinnung von Fasern: a Spaltung von Weide* (Salix alba)*; b Reinigung des Kambiums von Weide* (Salix alba)*; c–d Schaben von Großer Brennnessel* (Urtica dioica).

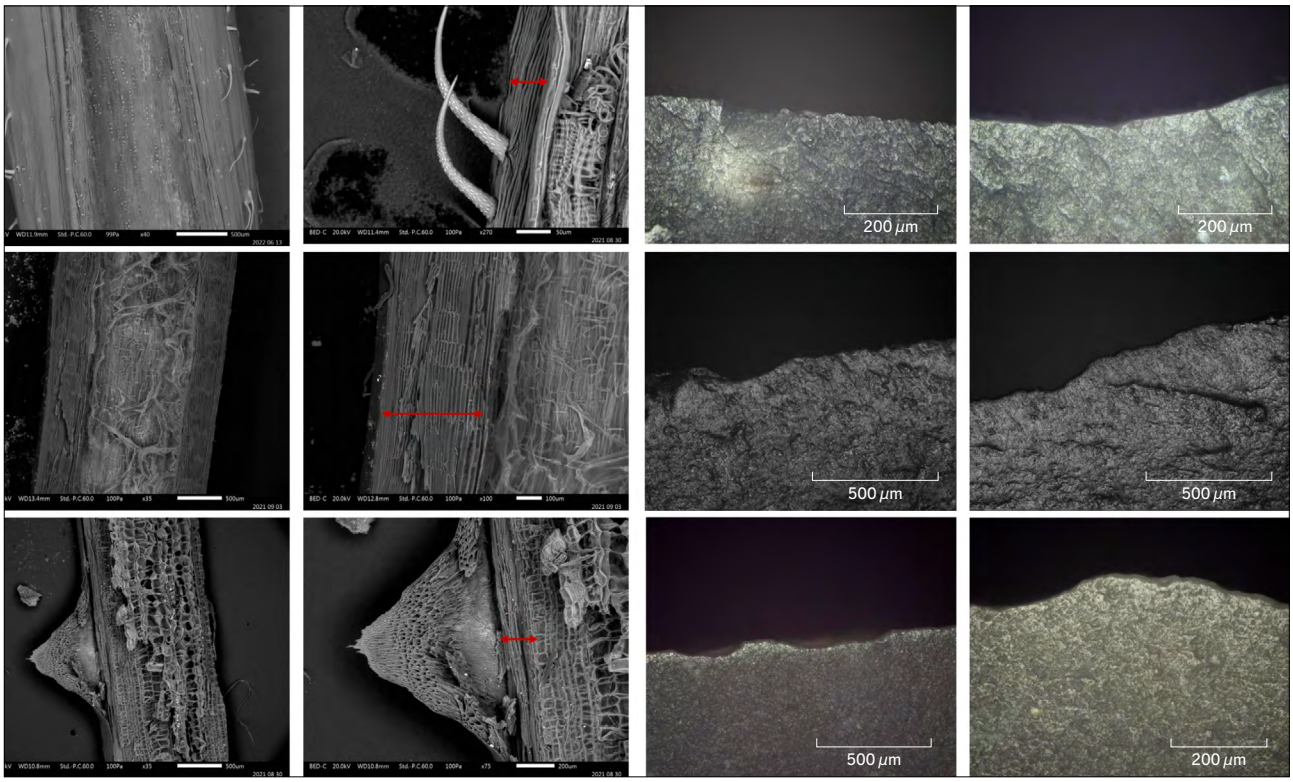


**Fig. 10** Development of wear patterns on the ventral edge of experimental tools due to increasing use duration, and different plants used with the aim to extract fibres. From top to bottom: tools used to process nettles show weak edge rounding and minimal polish on the used edge; tools used for scutching flax show distinct striations and more pronounced edge rounding; tools used to scrape bramble demonstrate very well-developed edge rounding and polish.

***Abb. 10*** *Entwicklung von Abnutzungsspuren an der ventralen Kante von Versuchswerkzeugen aufgrund zunehmender Nutzungsdauer und verschiedener Pflanzen, die zur Gewinnung von Fasern verwendet wurden. Von oben nach unten: Werkzeuge, die zur Bearbeitung von Brennnesseln verwendet wurden, zeigen eine schwache Kantenabrundung und eine minimale Politur an der benutzten Kante; Werkzeuge, die zum Hecheln von Flachs verwendet wurden, zeigen deutliche Rillen und eine ausgeprägtere Kantenabrundung; Werkzeuge, die zum Schaben von Dornenstrauch verwendet wurden, zeigen eine sehr gut entwickelte Kantenabrundung und Politur.*

| Used part | Angle of work | Worked material | Plant part | Worked material details | Action | Duration | Prehensile mode |
|---|---|---|---|---|---|---|---|
| right edge | 90° | *Urtica dioica* | stem | fresh | cutting | 20' | hand-held |
| left edge | 70–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| right proximal part | 70° | *Linum usitatissimum* | stem | dry | scutching | 60' | hand-held |
| left edge | 70–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| right edge | 70–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| right edge | 80–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| left edge | 70–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| right edge | 70–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| right edge | 80–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| left edge | 75–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| left edge | 70–50° | *Linum usitatissimum* | stem | dry | scutching | 30' | hand-held |
| right edge | 80–50° | *Linum usitatissimum* | stem | dry | scutching | 60' | hand-held |
| left edge | 80–45° | *Linum usitatissimum* | stem | dry | scutching | 60' | hand-held |
| left edge | 90° | *Urtica dioica* | stem | fresh | cutting | 12' | hand-held |
| right edge | 90° | *Salix alba* | branch | fresh | cutting | 60' | hand-held |
| right edge | 90° | *blackberry wood* | branch | fresh | cutting | 60' | hand-held |
| facet | 80–45° | *Linum usitatissimum* | stem | dry | scutching | 60' | hand-held |
| facet and right edge | 80–45° | *Linum usitatissimum* | stem | dry | scutching | 60' | hand-held |
| facet and left edge | 80–45° | *hemp* | stem | dry | scutching | 60' | hand-held |
| facet and left edge | 80–45° | *hemp* | stem | dry | scutching | 60' | hand-held |
| left edge | 90° | *Amadou* | bark | dry | cutting | 60' | hand-held |
| left edge | 90° | *Amadou* | bark | dry | cutting | 5' | hand-held |
| left edge | 90° | *Amadou* | bark | dry | cutting | 15' | hand-held |
| right edge | 90° | *Amadou* | bark | dry | cutting | 30' | hand-held |
| right edge | 90° | *Amadou* | tubes | dry | cutting | 60' | hand-held |
| right edge | 90° | *Amadou* | tubes | dry | cutting | 5' | hand-held |
| left edge | 90° | *Amadou* | tubes | dry | cutting | 15' | hand-held |
| left edge | 90° | *Amadou* | tubes | dry | cutting | 30' | hand-held |
| right distal edge | 90° | *Equisetum Arvense* | stem | fresh | cutting | 30' | hand-held |
| right edge | 90° | *Dryopteris Filix-Mas* | stem | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Rubus (fruticosus)* | stem | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Corylus (avellana)* | branch | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Alnus (glutinosa)* | branch | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Rheum × hybridum (?)* | branch + leaf | fresh | cutting | 12' | hand-held |
| distal part | 90° | *Typha* sp. | leaf | fresh | cutting | 30' | hand-held |
| right edge | 90° | *Rubus (fruticosus)* | stem | fresh | cutting | 60' | hand-held |
| right edge | 90° | *Typha* sp. | stem | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Hematite* | / | dry | cutting | 30' | hand-held |
| right edge | 90° | *Salix alba* | branch | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Tilia* sp. | branch | fresh | cutting | 30' | hand-held |
| right edge | 90° | *Tilia* sp. | branch | fresh | cutting | 10' | hand-held |
| right edge | 90° | *Sandstone* | / | processed fresh surface | cutting | 30' | hand-held |
| right edge | 90° | *Equisetum Telmateia* | branch | fresh | cutting | 5' | hand-held |

| Used part | Angle of work | Worked material | Plant part | Worked material details | Action | Duration | Prehensile mode |
|---|---|---|---|---|---|---|---|
| left edge | 90° | *Equisetum Telmateia* | branch | fresh | cutting | 10' | hand-held |
| right edge | 90° | *Equisetum Telmateia* | branch | fresh | cutting | 30' | hand-held |
| left edge | 80–45° | *Equisetum Telmateia* | branch | fresh | scraping | 10' | hand-held |
| left edge | 90° | *Oak Quercus* | branch | fresh | cutting | 20' | hand-held |
| left edge | 90° | *Oak Quercus* | branch | fresh | cutting | 10' | hand-held |
| right edge | 45–90° (removing bark/ splitting) | *Salix alba* | branch | fresh | removing bark + splitting | 60' | hand-held |
| left edge | 90° | *Salix alba* | branch | fresh | splitting | 60' | hand-held |
| right edge | 90° | *Rubus (fruticosus)* | branch | fresh | removing blackberry spines | 60' | hand-held |
| left edge | 90° | *Rubus (fruticosus)* | branch | fresh | splitting | 60' | hand-held |
| right edge | 45° | *Salix alba* | branch | fresh | cleaning the cambium | 60' | hand-held |
| left edge | 90° | *Salix alba* | branch | fresh | hollowing branches | 60' | hand-held |
| right edge | 45° | *Salix alba* | branch | fresh | removing bark | 60' | hand-held |
| right edge | 80–45° | *Corylus (avellana)* | branch | fresh | scraping the bark | 60' | hand-held |
| left edge | 90° | *Tilia* sp. | branch | fresh | cutting bark for removal | 60' | hand-held |
| right edge | 90° | *Tilia* sp. | branch | fresh | cutting bark for removal | 265' | hand-held |
| right edge | 90° | *Tilia* sp. | branch | fresh | cutting bark for removal | 15' | hand-held |
| left distal edge | 90° | *Ulmus* sp. | branch | fresh | cutting bark for removal | 25' | hand-held |
| right edge | 45° | *Salix alba* | branch | fresh | removing outer bark from inner bark | 60' | hand-held |
| right edge | 90° | *Phalaris arundinacea* | leaf | fresh | splitting leaves in small fibres | 30' | hand-held |
| right edge | 45–90° | *Birch bark* | bark | fresh | cutting the bark | 30' | hand-held |
| left edge | 90° | *Phalaris arundinacea* | stem | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Urtica dioica* | stem | fresh | cutting | 30' | hand-held |
| left edge | 90° | *Dactylis glomerata* | stem | fresh | cutting | 30' | hand-held |

**Tab. 2** Overview of experimental conditions and materials used in plant processing experiments.

***Tab. 2*** *Übersicht über die Versuchsbedingungen und die bei den Pflanzenverarbeitungsexperimenten verwendeten Materialien.*

A subset of the experiments focused specifically on fibre processing (Tab. 2). For instance, when tools were used for scutching, i.e. breaking and scraping plant stems to extract fibres (Fig. 9), wear from this activity proved to develop particularly slowly, both in terms of macroscopic edge damage, microscopic edge rounding, and polish formation. Among the tested plants, bramble produced the most pronounced wear, followed by flax, and then nettle (Fig. 10). This hierarchy aligns with our general findings: bramble, being the hardest of the three and the richest in calcium oxalate crystals, resulted in greater abrasion of the stone tool edges. Plant hardness and biomineral composition are thus key drivers in wear formation when activities are similar.

In an additional exploratory experiment, we tested the efficiency of organic versus stone tools for extracting fibres from dry flax using a scutching motion. The tools included a retouched flint flake and a wooden knife, the latter modelled after so-called ›weaving swords‹ known from early Neolithic sites such as La Marmotta (Mineo et al. 2023). Scanning electron microscopic (SEM) analysis revealed clear differences in the condition of the fibres processed with each tool. The fibres processed with the flint flake proved significantly more fragmented and broken com-

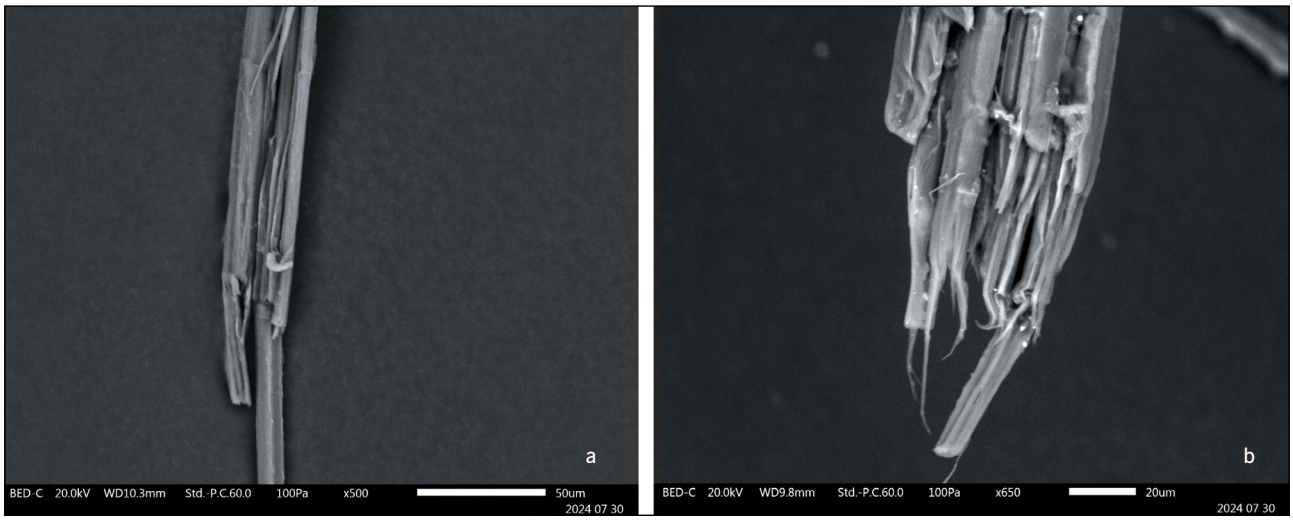


**Fig. 11a–b** SEM images of flax fibres processed using different tools: a flax fibres remain largely intact when processed with a wooden tool, indicating a gentler separation; b flax fibres show significant fragmentation after processing with a flint tool.

***Abb. 11a–b*** *REM-Bilder von Flachsfasern, die mit verschiedenen Werkzeugen bearbeitet wurden: a Flachsfasern bleiben bei der Bearbeitung mit einem Holzwerkzeug weitgehend intakt, was auf eine sanftere Trennung hindeutet; b Flachsfasern zeigen eine deutliche Fragmentierung nach der Bearbeitung mit einem Feuersteinwerkzeug.*

pared to those processed with the wooden tool. Indeed, the sharp edge of the stone tool tended to damage the fibres, producing sharp break points and splintered ends, whereas the wooden implement allowed for the separation of the fibres without breakage (Fig. 11). This observation confirms that stone may not have been the preferred raw material for tools used when working fibres.

Future phases of this experimental programme will focus on an exploration of fibre processing techniques, with particular attention to tool efficiency, wear development, and the preservation of fibre integrity across a broader range of plant species and tool types.

## Conclusions

In the absence of direct evidence for fibre processing, functional studies of stone tools (that include use-wear and residues) combined with experimental programmes are essential tools for better recognising plant processing and craft activities among prehistoric groups. While functional studies have already contributed significantly to our understanding of plant processing in the Palaeolithic, fibre processing, ropemaking, and clothing production remain the most challenging topics to address. As a result, most evidence remains indirect, even for the Upper Palaeolithic. An important caveat is that fibre working does not necessarily require stone tools and may have relied on perishable organic implements, meaning that its archaeological visibility is limited, with stone tools only being able to provide a very partial view of these technologies while also necessitating a continued investment in improving our understanding of fibre-related wear traces.

Different lines of evidence have shown that Neanderthals had an in-depth knowledge of various plants and exploited them for both subsistence and tool manufacturing purposes. For modern humans, the issue is far less debated, and while early evidence is still very sparse, expertise has been assumed. All evidence combined, it still seems that fibre processing has a very long history and that it is relevant to continue to invest in improving how these artisanal activities can be recognised archaeologically. We have demonstrated that this task is challenging due to the broad range of exploitable plants and tasks; however, an approach that integrates detailed experimental work with use-wear and residue analyses, as well as the elaboration of botanical reference libraries and trace libraries, appears promising. Initial results highlight the important role of the biomineral composition of plants in wear formation. This research will continue to be built upon in the future, and, hopefully, this approach will lead to a more robust reference framework and a better understanding of the long history of fibre processing among prehistoric hunter-gatherer groups.

## Acknowledgements

The research was part of a broader research project focussing on the functional investigation of Mesolithic sites in Flanders. We thank Christian Lepers, Carole Cheval and Sophie Bodart for their assistance in the experiments, and Dries Cnuts for his important contribution in the SEM analysis. Veerle Rots is indebted to the F.R.S.-FNRS. We are all indebted to the University of Liège for their financial support of this research. Finally, we extend our thanks to the editors and colleagues for their constructive feedback.

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## Source of figures

1–5 S. Tomasso, Liège
6–8 D. Cnuts, Liège
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# Stone Age Textiles – Materials, techniques, and the value of reconstructions

Eva IJsveld and Dorothee Olthof

**Zusammenfassung**

Textilien aus der Steinzeit – Materialien, Techniken und der Wert von Rekonstruktionen

*Steinzeitliche Kleidung wird oft mit Leder und Pelz in Verbindung gebracht, während das Wort »Textil« Bilder von Wolle, Spinnen und Weben auf großen Webstühlen hervorruft. Archäologische Funde zeigen uns jedoch, dass Pflanzenfasern die frühesten Textilmaterialien waren, die von der Menschheit verwendet wurden. Bast, Nesseln, Gräser und andere Pflanzenfasern wurden gedreht, gezwirnt, gezwirbelt und gewickelt, um Schnüre und Seile, Umhänge, Körbe, Hüte, Matten und sogar Schuhe herzustellen. In diesem Artikel untersuchen wir die Materialien und Techniken dieses frühen Textilhandwerks, die archäologischen Funde und ihre möglichen Verwendungszwecke sowie den Wert der Rekonstruktion alter Techniken und Gegenstände für wissenschaftliche und pädagogische Zwecke.*

**Schlagwörter** Pflanzenfasern, Steinzeittextilien, experimentelle Archäologie, Rekonstruktionen, Textilhandwerk

**Summary**

*Stone Age clothing is often associated with leather and fur, whereas the word ›textile‹ conjures images of wool, spinning, and weaving on large looms. However, archaeological evidence shows us that plant fibres were the earliest textile materials used by (wo)mankind. Tree basts, nettles, grasses, and other plant fibres were twisted, plied, twined, and coiled to make cordage and ropes, capes, baskets, hats, mats, and even shoes. In this article, we explore the materials and techniques of these early fibre crafts, the archaeological finds and their possible uses, as well as the value of reconstructing ancient techniques and objects for scientific and educational purposes.*

**Keywords** Plant fibres, Stone Age textiles, experimental archaeology, reconstructions, fibre crafts

## Introduction

In the popular view, people of the Stone Age all wore crude clothing made of bearskins. Some researchers even adhere to the view that until the Neolithic people wore nothing but skin clothing (Gilligan et al. 2024). The archaeological record, however, shows us that plant fibre textiles have been around since the Palaeolithic. Evidence from this ancient era is quite rare due to the fragile nature of the material. The oldest find so far is a 46 000–41 000-year-old piece of string (Hardy et al. 2020). In addition, 25 000-year-old imprints in clay from Dolní Věstonice, Břeclav District (Czech Republic), show several textile techniques and engravings on some ›Venuses‹ also suggest the use of textile materials (Soffer et al. 2000; Soffer et al. 2001; Olthof 2020). Mesolithic and Neolithic wetland sites, dry caves and glaciers have yielded extraordinary finds of Stone Age textiles: cordage, baskets, bags, nets, mats, capes, hats, and shoes, expertly made from a whole range of plant fibres.

The fragile textiles are rare in the archaeological record, but they once made up a large part of Stone Age material culture (Hurcombe 2014). Let us take a closer look at some Central and Western European finds, the materials they were made of, the techniques used to turn the fibres into objects, and the value of reconstructing these finds for scientific and educational purposes.

## Grasses, bast, and nettles

Plant fibres are the oldest known textile materials. Archaeological evidence for the large-scale use of wool does not appear before the Bronze Age (Grömer 2016). Our Stone Age ancestors used tree bast, grasses, nettles, and other plants to craft functional and beautiful textiles (Grömer 2016; Rast-Eicher 2016a; Rast-Eicher/Dietrich 2015). The most frequently used Stone Age plant fibres will be discussed below.

### Tree bast

Bast is the fibrous layer between the wood and the bark of a tree (Fig. 1). In spring, when the sap is rising, the bark can be pulled off the tree quite easily. The bast layers and bark are stuck together with pectins and lignins and must be separated. The easiest way to do this is by retting: putting the bark in (running) water until the bast layers separate from the tough bark and from each other (Fig. 2). Depend-

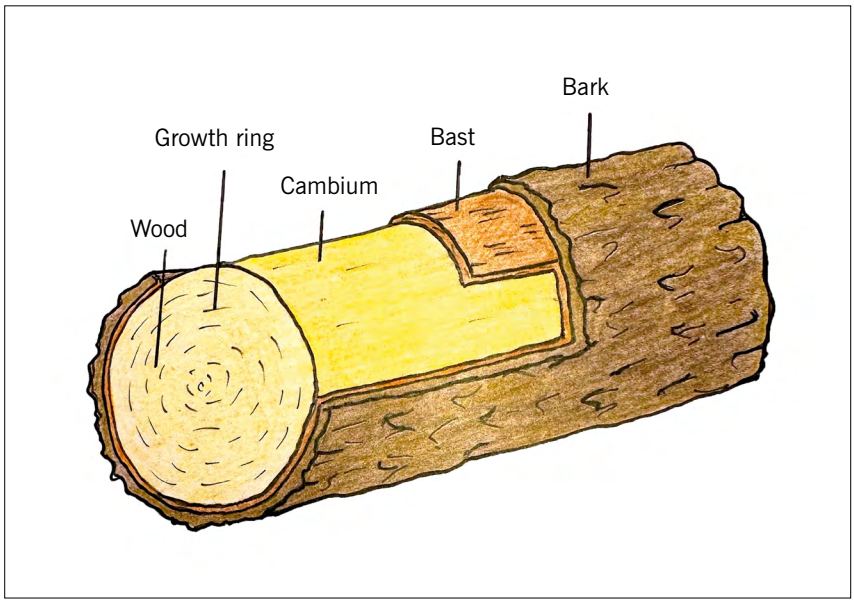


***Fig. 1*** *The bast layer of a tree is situated between the wood and the bark.*

***Abb. 1*** *Die Bastschicht eines Baumes befindet sich zwischen dem Holz und der Rinde.*

ing on the water temperature, this can take several weeks or months, with higher temperatures speeding up the process. After retting, the bast is rinsed and dried. It can then be stored until further use; it will keep for many years. Before use, it needs to be rehydrated to make it more pliable (Rast-Eicher/Dietrich 2015; Reichert 2020).

There are other ways of preparing the bast for crafts. The bast and bark layer of very fine twigs can be used without

**Fig. 2** Retted lime bast separates into many thin layers. The youngest inner layers are the finest, the layers close to the bark are coarser.

***Abb. 2*** *Gerösteter Lindenbast teilt sich in viele dünne Schichten auf. Die jüngsten inneren Schichten sind die feinsten, die Schichten in der Nähe der Rinde sind gröber.*

much preparation except for drying and rehydration. For finer work, the thin bark can be scraped off with a sharp knife. To speed up the retting process, it is also possible to boil bast in water or water with wood ash. The alkaline solution breaks down the pectins and lignins faster. The Indigenous peoples of the Pacific Northwest Coast softened cedar bast by beating it with wooden or stone implements before turning it into clothing. They even oiled the fibres to make the clothing water-repellent (Stewart 1984). Perhaps Stone Age people did something similar.

The most frequently used tree basts in the European Stone Age were lime (*Tilia* sp.), oak (*Quercus* sp.), and willow (*Salix* sp.). However, there are also finds of elm (*Ulmus* sp.) and poplar (*Populus* sp.) (Böhm et al. 2023; Olthof 2020), as well as unspecified coniferous bast (Hardy et al. 2020). Interestingly, during experiments, oak bast proved too brittle for cordage or plaiting, whereas it is regularly found in archaeological contexts (Reichert 2020). Clearly, the Stone Age fibre artists knew more than we do now, and more experiments are needed to evaluate different ways of preparing the fibres. Ethnographic studies could provide new ideas and techniques for this.

### Nettles and flax

Stinging nettles *(Urtica dioica)* and flax *(Linum usitatissimum)* are also bast fibres, only much finer than tree basts. Whereas flax was introduced to Europe by the first farmers at the beginning of the Neolithic, nettles are native plants that have been around for much longer (Grömer 2016). Like tree basts, the fibres of nettles and flax are found in the stems, under a (very thin) ›bark‹ and around the woody stem.

Flax is traditionally sown in April, around the 100$^{th}$ day of the year, and harvested about 100 days later, in July. Nettles are harvested in summer and early autumn when the stems have grown to full height.

In historical times, the stems of the plants were retted, broken, and heckled (combed) to extract and separate the fibres before spinning. In Neolithic textiles, the fibre bundles are usually not separated, and parts of the epidermis are sometimes still present. This points to another extraction method, with no or incomplete retting, possibly scraping the fibres without heckling (Gleba/Harris 2019; Rast-Eicher/Dietrich 2015).

### Grasses, rushes and sedges

The long, flexible stems of certain grasses *(Poaceae)*, rushes *(Juncaceae)*, and sedges *(Cyperaceae)* are very well suited for fibre crafts. ›Ötzi‹ from the Tisenjoch, South Tyrol (Italy), wore a cape made of grass (*Brachypodium pinnatum*; Egg/Spindler 2009), the Cueva de los Murciélagos, Province of Córdoba (Spain), yielded beautiful baskets and sandals made of esparto grass (*Stipa tenacissima*; Martínez-Sevilla et al. 2023), and many coiled baskets from the lake dwellings in the Alpine area have a core of grasses, rushes or sedges (Böhm et al. 2023).

These plants are harvested in July and August, dried, and stored until further use. Before plaiting, they must be rehydrated to make them flexible again. Esparto grass can be processed further by crushing the leaves to make them more pliable. Traditional esparto artisans also retted the grass in stagnant water for 20–40 days to make it more flexible. The Neolithic fibre artists of the Cueva de los Murciélagos used both crushed and uncrushed grass for their work, depending on the type of object they made, while their Mesolithic colleagues only used uncrushed grass. The archaeological finds showed no evidence of retting (Martínez-Sevilla et al. 2023).

Each plant fibre has its own season for harvesting and its own preparation method. Common to all fibres is the need to harvest, dry, and rehydrate them before use to restore their flexibility. Harvesting fibre plants would have been an important seasonal activity during the Stone Age year, for hunter-gatherers and farmers alike.

## Twisting, twining, coiling

The word ›textile‹ derives from the Latin word ›texere‹, which means to weave on a loom. In our modern understanding, most people would agree that objects made in other techniques, like knitting, felting or crochet, can also be called textiles. When studying Stone Age fibre arts, we definitely must broaden the definition of the word to include techniques other than weaving, since weaving on large looms is a relatively late development, probably originating in the Neolithic (Grömer 2016).

Stone Age finds show us a range of different textile techniques. The most prevalent ones will be discussed below. Here, ›textile‹ will mean any more or less flexible object or fabric that consists of connected fibres. All the different techniques which were used to make textiles have their own names. For clarity in communication with other (textile) archaeologists and craftspeople, it is important to use the appropriate names for the techniques. Calling everything ›woven‹ leads to confusion and misunderstanding (Banck-Burgess 2023).

### Twisting and plying

The string or thread is the basis of (nearly) all textile techniques and is also very useful on its own for binding, attaching, and hanging things. So perhaps it is not surprising that cordage dominates the Stone Age textile record (Böhm et al. 2023).

Cordage is made by twisting and plying fibres. Loose fibres are twisted in one direction (right or left, Z or S) to make a longer strand. Two or more strands are then plied together in the other direction (left or right, S or Z) to make durable cordage that does not untwist easily (Fig. 3a). This process can be done by hand and does not require any specialised tools.

So far, the oldest evidence of cordage is a 46 000–41 000-year-old find of very fine string from Abri du Maras, Dep. Ardèche (France). A Neanderthal had plied three

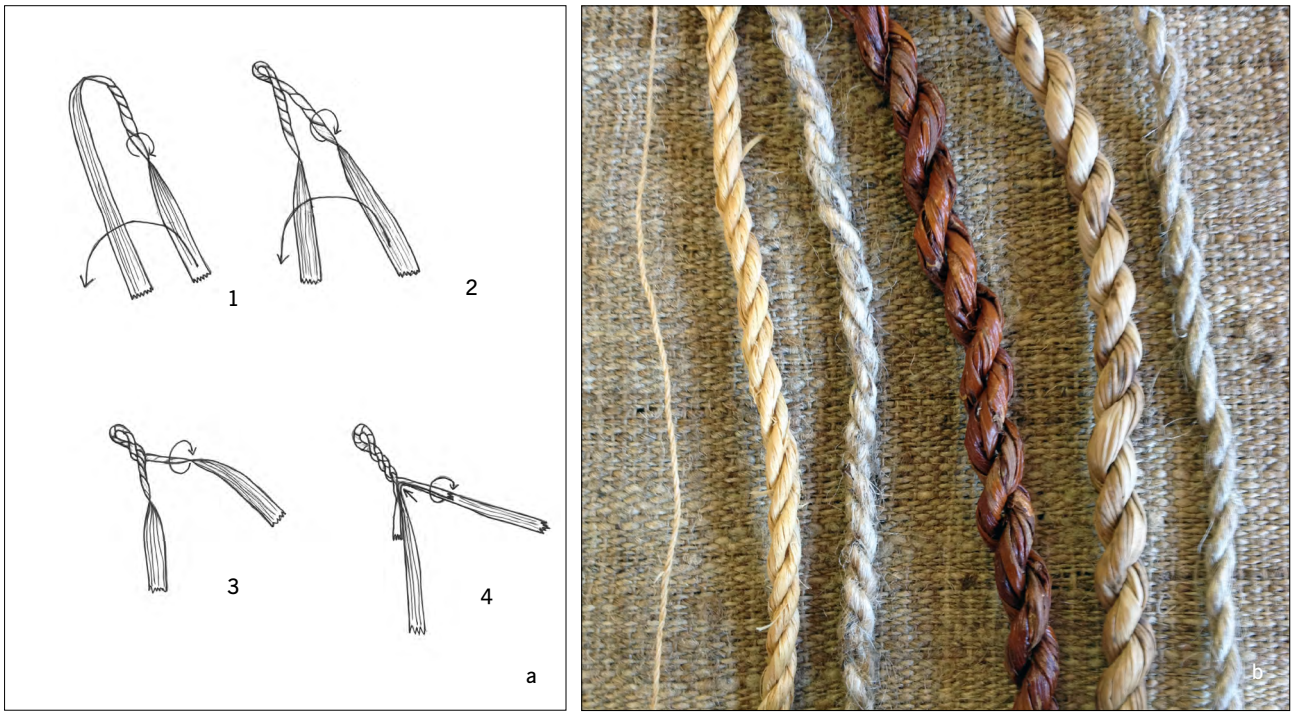


**Fig. 3a–b** Cordage. a Plying cordage with two strands. b Recreations of Stone Age cordage. From left to right Abri du Maras, Dep. Ardèche (France; 0.5 mm Ø), Lascaux, Dep. Dordogne (France; 6–8 mm Ø; both in lime bast), nettle string from Hardinxveld-Giessendam, South Holland Province (Netherlands), and cordage in willow, rush and flax.

***Abb. 3a–b*** *Schnüre. a Verzwirnen von Schnüren mit zwei Strängen. b Nachbildungen von steinzeitlichen Schnüren. Von links nach rechts Abri du Maras, Dep. Ardèche (Frankreich; 0,5 mm Ø), Lascaux, Dep. Dordogne (Frankreich, 6–8 mm Ø; beide aus Lindenbast), Nesselschnur aus Hardinxveld-Giessendam, Provinz Zuid-Holland (Niederlande), und Schnüre aus Weide, Binsen und Flachs.*

twisted pieces of coniferous tree bast into a string with a thickness of just 0.5 mm (Hardy et al. 2020). Another Palaeolithic piece of rope has been found in Lascaux, Dep. Dordogne (France; Glory 1959). More than 20 000 years old (Valladas et al. 2013), it is younger than the Neanderthal string and easier to see: it was a three-ply cord, 6–8 mm thick and 30 cm long. The exact material could not be determined, but it was a plant fibre, probably tree bast (Barber 1991, 40). From the Mesolithic onwards, there are many finds of strings, ropes, and threads all over Europe, made of plant fibres like nettle, willow, lime, and other tree basts (Fig. 3b; Böhm et al. 2023; Louwe Kooijmans et al. 2001; Rast-Eicher/Dietrich 2015).

## Knotting and netting

A sufficient length of string can be turned into a net by knotting. One of Europe's oldest fishing nets has been found in Antrea (today Kamennogorsk, Leningrad Oblast [Russia]). It was made of willow bast string and is dated around 10 400 cal BP (Miettinen et al. 2008). Later Mesolithic and Neolithic European wetland sites have yielded many net fragments, all made of plant fibres and constructed with one of the following knots: the sheet bend, the reef knot, and the overhand knot or ›Pfahlbauknoten‹ (Fig. 4)[1]. Mesh sizes vary, as does the thickness of the string, probably in relation to the function of the net. Nets could be used for fishing, but also for gathering, transport, hunting birds, and storage (Böhm et al. 2023; Louwe Kooijmans et al. 2001; Rast-Eicher/Dietrich 2015). Netting needles and mesh sticks are useful tools for making nets with consistent loop sizes.

## Twining

In a twined fabric, a passive system of fibre bundles (the warp) is entwined by an active element consisting of two (or more) fibre bundles. The active fibre bundles are plied, just as in cordage making, except that in every turn there is a passive fibre bundle between the active elements (Fig. 5a). In this way, a fabric is created. Depending on the thickness of the fibre bundles and the closeness of the twining, the fabric can be thin and soft or thick and stiff (Fig. 5b). No tools are needed, just hands, though for large projects it can be practical to suspend the warp from a frame.

The technique can be utilised to make mats, baskets, bags, and hats, but some fragments are so fine – made with fibre bundles of just a few millimetres in diameter – that use as clothing can be envisioned. Ethnographic and archaeological evidence shows us that throughout history and across the globe, from New Zealand to Japan and from the Stone Age to

1 Named after many finds from the lake dwellings in the Alpine area.

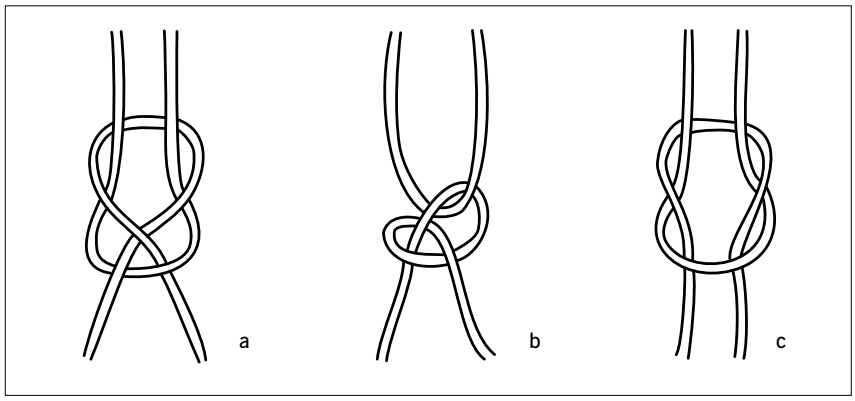


**Fig. 4a–c** Knots used for Stone Age nets: the sheet bend (a), the overhand knot (b), and the reef knot (c).

***Abb. 4a–c*** *Knoten, die für steinzeitliche Netze verwendet wurden: der Bogenknoten (a), der Überhandknoten (b) und der Weberknoten (c).*

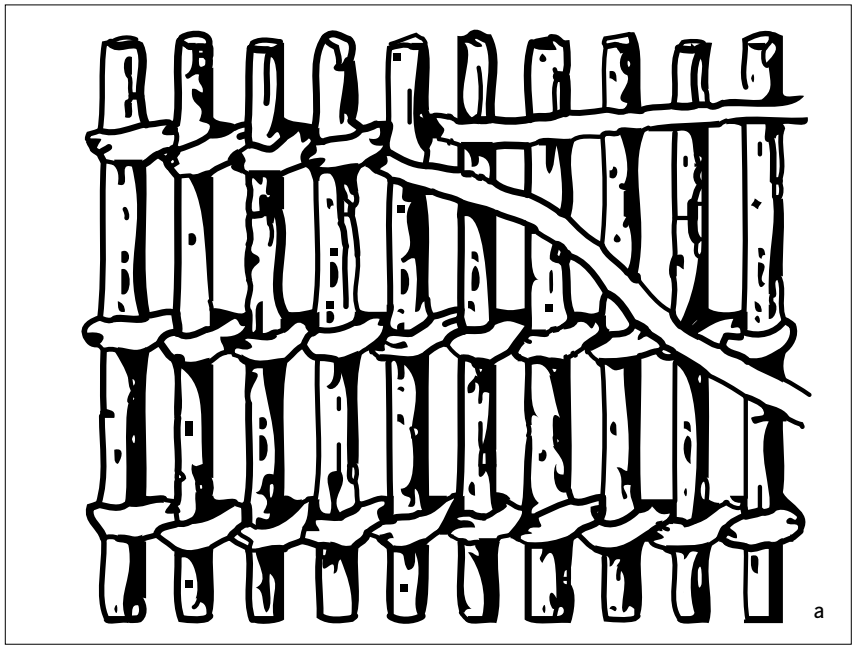

**Fig. 5a–b** Twining a fabric. a Twining a fabric with two active fibre bundles around the passive warp fibres. b Variations in twining, all based on techniques seen in archaeological finds from pile dwellings in the Alpine area (fibre bundles approx. 1.5–2.0 mm Ø).

***Abb. 5 a–b*** *Bei der Zwirnbindung werden zwei aktive Faserbündel um die passiven Kettfasern gezwirnt. b Zwirnbindungsvariationen, die alle auf Techniken basieren, die an archäologischen Funden aus Pfahlbauten im Alpenraum festgestellt wurden (Faserbündel ca. 1,5–2,0 mm Ø).*

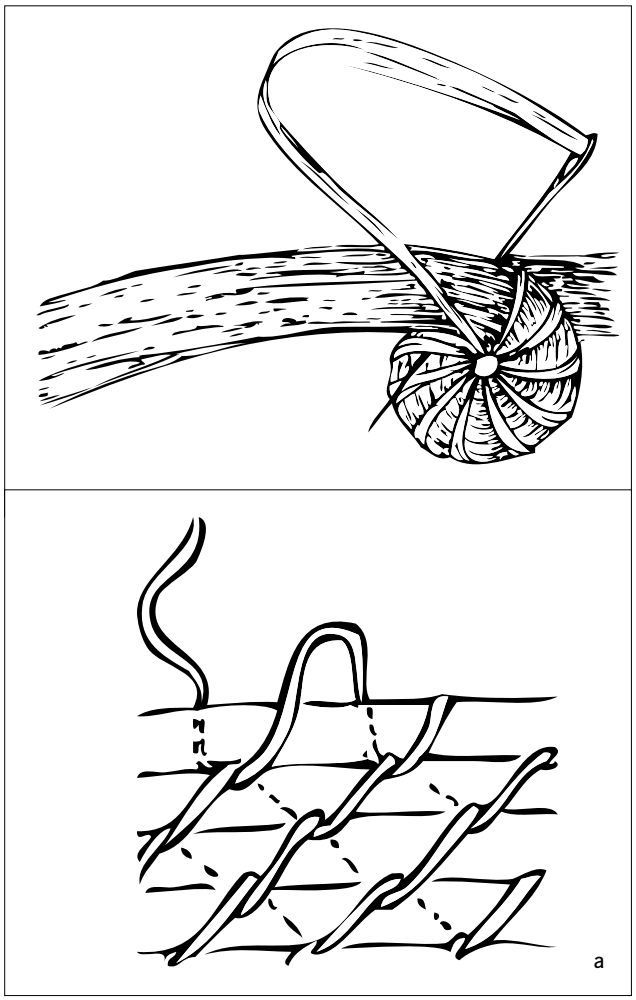


**Fig. 6a–b** a The coiling technique. b A coiled basket made of rushes and lime bast (coiled bundles c. 5 mm Ø).

***Abb. 6a–b*** *a Spiralwulstflechten. b Ein gewickelter Korb in Spiralwulsttechnik aus Binsen und Lindenbast (gewickelte Bündel von ca. 5 mm Ø).*

the present time, twined plant fibre clothing was made and worn by many people (Böhm et al. 2023; Olthof 2020; Rast-Eicher/Dietrich 2015).

## Coiling

Coiling is a technique where a passive fibre bundle is rolled into a spiral and sewn with an active fibre bundle (Fig. 6). Coiling always starts at the centre and spirals outwards. A needle or an awl is a useful tool for this technique. There are numerous finds of coiled fragments from Stone Age wetland sites, often made of monocotyledonous stems as the passive bundles and bark strips as the binders. They are usually interpreted as baskets, used for storage, gathering, or cooking. The finer fragments could perhaps have come from hats (Böhm et al. 2023; Rast-Eicher/Dietrich 2015). Sometimes, the fibres have not survived, but their imprint in the soil has. At Almere-Hogevaart, Flevoland Province (Netherlands), imprints of four coiled mats of at least 1 m diameter have been found in a clay-rich pit. They are dated to the Early Neolithic period, around 4300 cal BC, and were probably used as floor coverings during pottery making (Hogestijn/Peeters 2001).

## Looping

There are many terms for this technique: looping, knotless netting, and needle binding. It is the craft of making textiles from loops with (relatively) short pieces of yarn. There are endless variations possible in how the loops are stitched through each other. The oldest find so far comes from the Nahal Hemar cave in Israel and can be dated to 8000 cal BC. It is a small fragment in simple looping (Fig. 7a). Mesolithic sites in Northern Europe, like Friesack, Havelland District (Germany), and Tybrind Vig, Funen (Denmark), have also yielded examples of looping techniques (Fig. 7b), as have the Neolithic lake dwellings (Rast-Eicher/Dietrich 2015). Looping is suitable for making nets, bags, baskets, hats, and hairnets. Some variations can be done entirely by hand; for others a blunt needle is a useful tool (Claßen-Büttner 2012).

## Weaving

A woven fabric consists of a passive element, the warp, and an active element, the weft, that are interlaced at right angles. The simplest form is called plain weave or tabby: over one thread, under one thread (Fig. 8). When this is done with stiff materials, like bark strips or rushes, the result will be a mat or a basket, and the technique is usually called plaiting. Actual weaving is done with long, thin, flexible threads and produces a soft, flexible fabric (Fig. 8b). To keep the warp threads under tension they are stretched on a frame or a loom. To avoid having to plait the weft over one and under one thread manually, at some time in Prehistory, the heddle rod was invented to separate the even and uneven threads of the warp and create a weaving shed. Now, it was possible to place the weft between the two layers of the warp all in one go: the loom was invented, one of the first machines invented by (wo)man. It made weaving faster and more efficient. This invention probably originated in the Near East and spread through Europe with the first farmers in the Neolithic period (Grömer 2016).

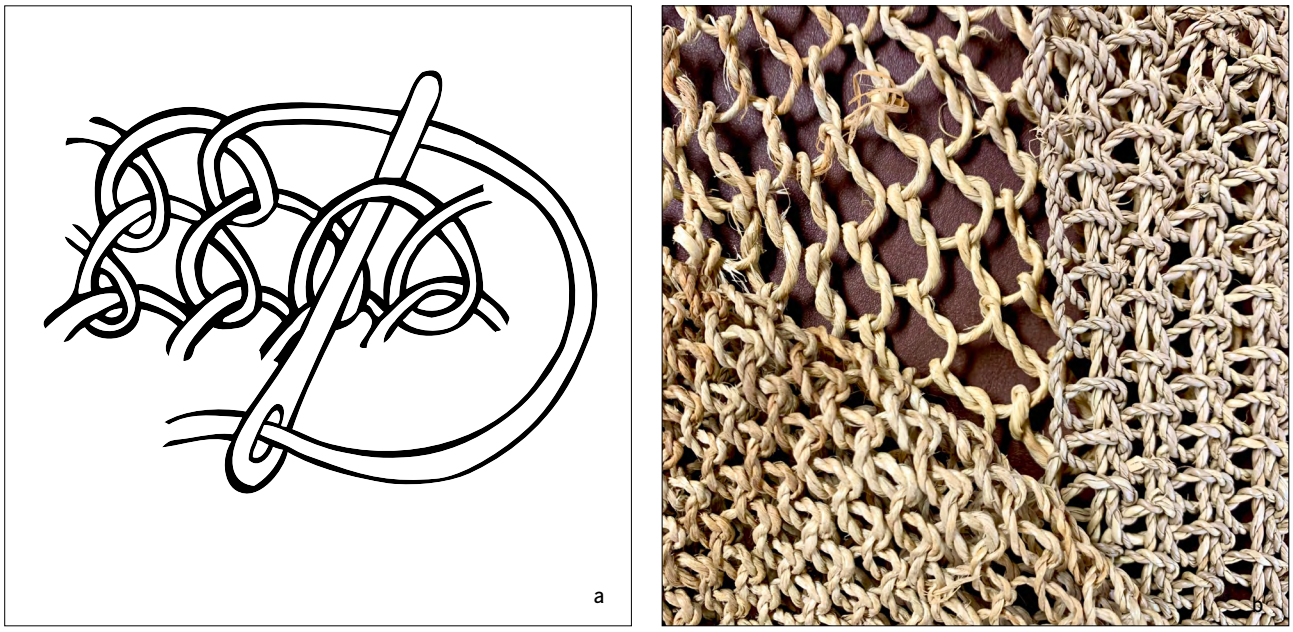


**Fig. 7a–b** Looping techniques. a Simple looping is done by sewing loops into each other. b Reconstructions of looping techniques from the Mesolithic sites at Friesack, Havelland District (Germany), and Tybrind Vig, Funen (Denmark). Cordage approx. 1.5–2.0 mm Ø.

***Abb. 7a–b*** *Schlingentechnik. a Einfache Schlingen werden durch das Ineinandernähen von Schlingen hergestellt. b Rekonstruktionen von Schlingentechniken aus den mesolithischen Fundstellen von Friesack, Lkr. Havelland, und Tybrind Vig, Fünen (Dänemark). Schnüre ca. 1,5–2,0 mm Ø.*

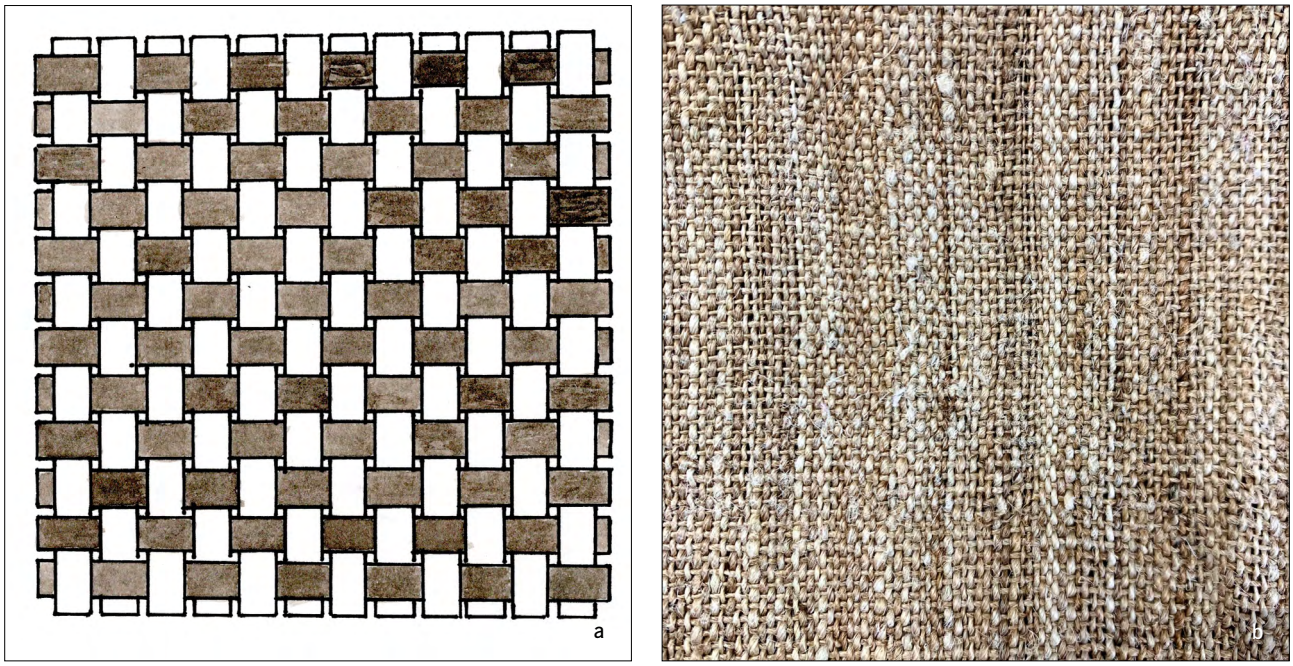


**Fig. 8a–b** Plain weave. a The structure of plain weave or tabby: over one thread and under one thread. b Plain weave modern nettle fabric from Nepal (10 threads per cm).

***Abb. 8a–b*** *Leinwandbindung. a Die Struktur von Leinwandbindung oder Tabby: über einem Faden und unter einem Faden. b Modernes Nesselgewebe in Leinwandbindung aus Nepal (10 Fäden pro cm).*

All Neolithic woven textiles are made in plain weave. The fibres of choice are often flax, but surprisingly, woven lime bast textiles also existed. At Zurich-Mythenquai (Switzerland), a woven lime bast fabric has been found that looks exactly like a piece of linen fabric to the naked eye. It is dated to the Late Neolithic Corded Ware culture (Banck-Burgess 2020).

Once weaving on looms was invented, the other textile techniques did not disappear. Twining with bast fibres remained the most utilised fabric-making technique during the Neolithic, even after the introduction of the loom. Finds at Must Farm, Cambridgeshire (United Kingdom), and the lake dwelling sites in the Alpine region show evidence that all the techniques were still in use during the Bronze Age

**Fig. 9** Neolithic lime bast shoe from Maur-Schifflände, Canton of Zurich (Switzerland).

***Abb. 9*** *Neolithischer Lindenbast-Schuh aus Maur-Schifflände, Kanton Zürich (Schweiz).*

(Böhm et al. 2023; Harris/Gleba 2024; Rast-Eicher/Dietrich 2015). Some crafts, like ropemaking, coiling and netting, have survived until the present time.

## Recreating Stone Age clothing

Stone Age textiles usually do not look like much during and after excavation. They are fragmented and torn; to the untrained eye, they are just brown blobs of fibrous material. It is difficult to envisage their original colour and appearance, the shape of the original object, how they felt (soft, hard, smooth, hairy, stiff) and what it would be like to wear or use them. From a technical point of view, the study of the preparation of the plant fibres, the textile technique used, the working sequence, the possible tools involved, and the amount of material required helps us better understand this craft.

Therefore, the recreation of Stone Age textiles and clothing is an invaluable tool for studying and understanding the finds and presenting them to the public. The following two case studies will highlight this.

### The shoes from Maur-Schifflände

During underwater excavations in the Greifensee at Maur-Schifflände, Canton of Zurich (Switzerland), in 2017–2018, fragments of more than 40 lime bast shoes came to light, dated to around 3000 BC. All sizes were represented, from small children's shoes to large adult sizes, and some were nearly completely preserved (Fig. 9)[2]. The Cantonal archaeology Zurich asked the authors to replicate two shoes for an exhibition about this unique find.

Reconstructing the shoes required studying the finds very closely and questioning every detail we saw: the number of bast strips, construction of the heel, plaiting technique of the sole and the upper, number of shoelaces, and so on. We found that all the shoes were of the same model: plaited of nine lime bast strips in rep (over one, under one, very close together), starting at the heel and continuing to the toes. There, the strips were plaited over the top of the foot as a twined tongue. The soles of the shoes were reinforced with a sole profile of twisted lime bast strips attached to the soles in a figure eight pattern. The shoes were tied to the foot with shoelaces of plied lime bast (Fig. 10). Some construction details remained unclear, so we compared the Greifensee shoes to other Neolithic lime bast shoe finds from lake dwellings. Unfortunately, that did not answer our questions, although it showed us that the other shoes were most probably made in the same way as those from Greifensee: plaited in rep, with a twined tongue and a sole profile. The traces of the tongue and sole profile were not as clear as in the Greifensee shoes and, therefore, had not been recognised before. However, once we had seen these elements, we could not

2 Pers. comm. A. Huber, Kantonsarchäologie Zürich.

**Fig. 10** Reconstruction of an adult-sized lime bast shoe from Maur-Schifflände, Canton of Zurich (Schwitzerland). The heel, sole and sides are plaited in rep, the tongue is twined, and the underside of the sole is reinforced with a sole profile; no scale.

***Abb. 10*** *Rekonstruktion eines Lindenbast-Schuhs in Erwachsenengröße aus Maur-Schifflände, Kanton Zürich (Schweiz). Die Ferse, die Sohle und die Seiten sind geflochten, die Zunge ist gezwirnt, und die Unterseite der Sohle ist mit einem Sohlenprofil verstärkt; o. M.*

unsee them and could distinguish them in the shoes from Allensbach, Bern, and probably Sipplingen (Feldtkeller/Schlichtherle 1987; Moll-Dau 2015; Wiesner/Stelzner 2011).

Eventually, we made a small children's shoe and an adult shoe in lime bast for the exhibition and for educational purposes. In addition, we made three pairs of raffia shoes in different sizes for handling by the public. Our only tools were our hands, a hollow awl and a sharp piece of flint to cut off excess lime bast. It took 11 hours to make the adult shoe. It should be noted that this is not representative of the time investment of prehistoric people, as they were probably much quicker and more routinized. As much as possible, we based our reconstructions on archaeological evidence. Where the evidence was missing or unclear, we made educated guesses based on our observations and what we thought would be plausible solutions.

The reconstruction of the shoes required an extremely detailed analysis of the finds. It gave us new insights into the construction of Neolithic lime bast shoes, the working sequence, the tools needed, and even new ideas about former shoe finds. The reconstructions are not proof; however, they are a possibility. One can make several different reconstructions based on these same finds, depending on which decisions are made about the unclear details.

**Fig. 11** The reconstructed lime bast cloak of Zurich-Parkhaus Opéra, made by E. IJsveld; no scale.

***Abb. 11*** *Der rekonstruierte Mantel aus Lindenbast von Zürich-Parkhaus Opéra, hergestellt von E. IJsveld; o. M.*

The public also learned a great deal about the shoes during the exhibition and hands-on activities: the original appearance of the shoes (golden-yellow, not brown!), the feeling of the lime bast, and the fit of the shoes when wearing them. Nevertheless, some questions remain, the biggest one being: How long did these shoes last? We do not really know yet. After wearing them for a week in a Stone Age setting, the sole profile in the toe area started to disintegrate. However, this did not mean the shoes should be discarded, because the profile could be replaced. Perhaps making the profile from coarser bast fibres would extend its life span. There is always room for more experiments!

## The lime bast cape from Zurich-Parkhaus Opéra

During excavations at Zurich-Parkhaus Opéra (Switzerland) in 2010–2011, the remains of a Neolithic pile dwelling settlement were found. Among the many interesting finds was a fragment of a cape, dated to around 4000–3500 cal BC. It was made of finely twined lime bast fibres, with the rows of twining about 1 cm apart. The complete neckline and parts of the side edges were preserved, including a fringe of bast fibres along these edges (Rast-Eicher 2016b). The good preservation of the garment and the clear photographs and drawings in the publication made it possible for E. IJsveld to make a plausible reconstruction.

The first step was sorting the raw material. Long, straight lime bast strips were selected and torn into thinner strips of 0.5–0.8 cm. Reconstructing the cloak started at the neckline with a 4 mm-wide string. Strips of lime bast were folded over this string and twined closely together. When all the strips had been fastened along the neckline over a length of 30 cm, the second row of binding was added 1 cm lower. To make the cape wider over the shoulders, extra strips of lime bast were added into the twining of the next rows. This resulted in folds in the cape, which were also clearly visible in the original find. The wider the cape got, the longer it took to twine a row. The widest row took an 8-hour working day to finish; the complete cape took about a month (30 days of 8 hours). The reconstructed cape is 1 m long; the length of the original is not clearly known, as it was incompletely preserved (Fig. 11).

**Fig. 12** Adding the fringe to the edges of the cloak of Zurich-Parkhaus Opéra; no scale.

***Abb. 12*** *Hinzufügte Fransen an den Rändern des Mantels von Zürich-Parkhaus Opéra; o. M.*

The final step was adding the fringe to the neckline and the side edges. This could have been done simultaneously with the twining or added after the twining was finished. The correct working sequence cannot be deduced from the find; E. IJsveld opted for the latter possibility. With a needle, fibre bundles were sewn into the twining along the neck and the starting cords of the edges to form a long fringe that covered the shoulders and the front of the cape (Fig. 12). Apart from the needle and a sharp flint to cut the fibre bundles, no tools were used for making this cloak.

The cape from Zurich-Parkhaus Opéra is not a unique find. Additional Neolithic plant fibre capes are known: as mentioned above ›Ötzi‹ had a grass cape (Egg/Spindler 2009), and other lake-dwelling settlements, such as Lüscherz-Innere Dorfstation, Canton of Bern (Switzerland), and Horgen-Scheller, Canton of Zurich (Switzerland), have also yielded fragments of capes, complete with fringes. In the ethnographic record, plant fibre capes worn against rain and cold are a common garment worldwide. Perhaps they were a regular piece of clothing in the Neolithic as well (Rast-Eicher 2016b).

However, is the cloak functional? The twining is fine, but there are still small gaps between the fibre bundles, so will it repel the rain? E. IJsveld tested the garment during heavy rain and was quite convinced. Her shoulders got slightly wet, but that could be remedied by adding more fringes to the neckline. After the rain, the cape dried quickly in the wind, which was an added bonus: a win for Stone Age technology!

## Discussion

Plant fibre textiles must have constituted a large part of Stone Age material culture, more prevalent than, for instance, stone tools (Hurcombe 2014). Gathering and preparing the fibres for textile use must have played an important part in the seasonal activities of Stone Age (wo)man. Mats, nets, baskets, ropes and strings, hats, shoes, capes, and other pieces of clothing were made of plant fibres like tree basts, nettles, grasses, rushes, sedges, and flax in many different techniques: twisting and plying, netting and knotting, coiling, twining, looping, and weaving (Böhm et al. 2023; Olthof 2020; Rast-Eicher/Dietrich 2015). Unfortunately, fibres are fragile and are rarely preserved in the archaeological record. When they are, the once beautifully plaited objects have usually turned into ›brown blobs‹ that are difficult

to appreciate for non-textile archaeologists and the public. Therefore, they are often neglected.

Reconstructing these finds in their original materials can be a very informative and rewarding way of studying them and presenting them to the public. First of all, making a reconstruction requires an extremely detailed analysis of the archaeological object to find the correct material, technique, and *chaîne opératoire* used to make the artefact.

Next, this archaeological evidence must be translated into a craft by a skilled craftsperson familiar with the techniques and materials required. Craftspeople use different skills than archaeologists to analyse and understand objects: experience, practice, muscle memory, intuition, and an in-depth knowledge of the (im)possibilities of the raw material and the technique. These skills may not be highly scientific, but they are highly informative and were used by Stone Age craftspeople as well. They make a valuable contribution to studying past societies. All this in-depth studying and working with the finds and materials often creates new insights and new questions, thereby furthering the scientific process and archaeological interpretations.

Reconstructed Stone Age textiles bring the artefacts back to life: they reveal the original colour, texture, and appearance of the objects. They can be looked at, touched, and experienced as archaeological finds can never be, because the originals are too fragile to handle and are usually quite decayed. Archaeologists and the public alike can wear Stone Age shoes, test a bast cape in the rain, smell retted lime bast, or feel the softness of nettle fibres. Where our modern society (and hence archaeology) is mostly focused on visual material culture, reconstructions allow an interaction with all the senses, thus contributing to a sensory archaeology and a deeper understanding of the past (Hurcombe 2014).

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# Fibre-based technologies of the Last Hunter-gatherers and First Farmers in southern Europe: Baskets, cords and footwear from the Cueva de los Murciélagos site (Albuñol, Granada)

Maria Herrero-Otal, Ingrid Bertin, Raquel Piqué, and Francisco Martínez-Sevilla

**Zusammenfassung**

Faserbasierte Technologien der letzten Jäger und Sammler und der ersten Bauern in Südeuropa: Körbe, Schnüre und Schuhwerk aus der Cueva de los Murciélagos (Albuñol, Granada)

*Materielle Kultur aus organischen Komponenten bietet unschätzbare Einblicke in die handwerklichen Fähigkeiten, technologischen Innovationen und Anpassung an die vorhandenen Ressourcen prähistorischer Gesellschaften. Ihre Vergänglichkeit hat jedoch oft unser Verständnis ihrer vielfältigen und komplexen Anwendungen eingeschränkt. Fundplätze mit außergewöhnlichen Erhaltungsbedingungen bieten einzigartige Möglichkeiten für eingehende Studien der materiellen organischen Kultur. Ein solches Beispiel ist die Fundstätte Cueva de los Murciélagos, Provinz Granada, im Süden der Iberischen Halbinsel, die einige der ältesten, umfangreichsten und am besten erhaltenen faserbasierten Objekte der letzten Jäger und Sammler und der ersten Ackerbaugemeinschaften in Südeuropa geliefert hat. In dieser Studie werden die organischen faserbasierten Materialien – sowohl pflanzlicher als auch tierischer Herkunft – durch eine Multi-Proxy-Untersuchung mithilfe von Mikroskopie und biomolekularen Methoden neu untersucht. Die Ergebnisse zeigen die Verwendung von Espartograsblättern und Sehnen von drei verschiedenen Tierarten zur Herstellung von Grabbeigaben und Alltagsgegenständen. Die Funde der Ausgrabungstätte beleuchten das, was in der Archäologie als ›unsichtbare Technologien‹ bezeichnet wird, und erweitert unser Verständnis für die Erfindungsgabe und den Einfallsreichtum dieser früh- und mittelholozänen Gesellschaften.*

**Schlagwörter** Organische Materialien, Pflanzenfasern, Tierische Sehnen, Archäobotanik, Biomolekulare Analyse

**Summary**

*Material culture made of organic components provides invaluable insights into the craftsmanship, technological innovation and resource adaptations of prehistoric societies. However, its perishable nature has often limited our understanding of its diverse and complex applications. Sites with exceptional preservation conditions offer unique opportunities for in-depth studies of perishable material culture. One such example is the Cueva de los Murciélagos site, Granada Province, in southern Iberia, which has yielded some of the oldest, most extensive and best-preserved fibre-based objects known from the last hunter-gatherer and first farming communities in southern Europe. This study re-examines the organic fibre-based materials – of both plant and animal derivation – through a multi-proxy investigation using microscopy and biomolecular methods. The results reveal the use of esparto grass leaves and sinews from three different animal species to produce funerary and everyday objects. The site's discoveries illuminate what have been termed ›invisible technologies‹ in archaeology, broadening our understanding of the ingenuity and resourcefulness of these early Early and Middle Holocene societies*

**Keywords** Organic materials, plant fibres, animal sinew, archaeobotany, biomolecular analysis

## Introduction

Our understanding of the origins and development of technologies based on organic raw materials remains limited because of their rare preservation in the archaeological record, which is possible only under specific conditions like lack of humidity or in wet, oxygen-free environments. This preservation bias has significantly distorted our understanding of the role of these technologies in human evolution and social organisation. While a few archaeological sites have provided direct evidence for plant and animal-based crafts, these findings are often related to a narrow range of activities and/or products. This is the case with Palaeolithic wooden weaponry (e.g. Schoch et al. 2015; Leder et al. 2024) or digging sticks (Rios-Garaizar et al. 2018; Aranguren et al. 2018). Beyond the wooden remains that survive, the few exceptionally well-preserved Mesolithic sites, such as Starr Carr, North Yorkshire, United Kingdom (Milner et al. 2018) or Zamostje, Moscow Oblast, Russia (Lozovskaya/Lozovski 2016) and others[1], and Neo-

1 Gramsch 2000; Gramsch 2006; Lübke et al. 2011; Andersen 2013; Skaarup/Grøn 2004; Glykou 2016; Bailey et al. 2020.

lithic sites, such as La Draga, Catalonia, Spain (Piqué et al. 2015) or La Marmotta, Autonomous Province of Bolzano – South Tyrol, Italy (Caruso et al. 2021), show the wide range of plant-based artefacts and raw materials used, opening exceptional windows on the role of these technologies for past societies.

In the case of animal products used for crafts in prehistory – such as sinew, feathers (cf. Kirkinen in this volume), and leather – the evidence is even more limited. However, a few extraordinary cases have provided glimpses into their use. Sinew, for example, has been identified in association with Palaeolithic composite tools such as hafted stone points, where microscopic analysis of residues has revealed traces of collagen fibres used as binding material (Golovanova et al. 2024). Leather artefacts are similarly rare but have been recovered in waterlogged or arid environments where preservation conditions are favourable. For instance, leather shoes from the Chalcolithic period were discovered in the Areni-1 Cave, Vayots Dzor Province in Armenia, showcasing the sophisticated techniques used to process and stitch animal hides (Pinhasi et al. 2010). In addition, the discovery in the Alps of Ötzi, the Iceman, South Tyrol, Italy, has revealed the extensive use of leather and fur as well as plant material for clothing and equipment, shedding light on prehistoric craftsmanship (Egg/Spindler 1993; Junkmanns et al. 2019).

Interdisciplinary approaches to plant-based artefacts integrating archaeobotanical and biomolecular disciplines are essential to fill this gap. These rare findings underscore the importance of interdisciplinary approaches, such as protein residue analysis and experimental replication, to better understand the role of animal products in prehistoric technologies and their ecological significance. Archaeobotanical studies applied to the identification of plant raw materials used and plant transformation processes have a long history[2]. Other approaches, such as Gas Chromatography coupled with Mass Spectroscopy (GC-MS), have been developed recently; they allow the identification of glues, tars and other plant exudates and have demonstrated the antiquity of some of the processes for their production (Regert 2004; Wadley et al. 2015). More recently, proteomic approaches based on high resolution mass spectrometry have been utilised and rapidly developed for the identification of ancient proteins (Hendy 2021; McGrath et al. 2019).

However, such evidence is insufficient to capture the full complexity of the ecological and technological knowledge embedded in these practices. The lack of a broader data set limits our capacity to appreciate the sophistication and adaptability of ancient human societies in their use of organic resources, as well as the relationship between these technologies and their surrounding environments. In this paper, we present a summary of the results of the interdisciplinary research carried out on the organic artefacts from the site of Cueva de los Murciélagos (Albuñol, Spain). This site offers a unique opportunity to study technologies based on plant and animal raw materials, thanks to the extraordinary preservation of items made possible by the arid conditions of the cave. The exceptional state of these remains allows a detailed reconstruction of past technological practices and ecological knowledge, providing valuable insights into the use and processing of organic resources in prehistoric contexts.

## Archaeological context and materials

### The Cueva de los Murciéalgos site: description and research history

The Cueva de los Murciéalgos site is located in southeastern Iberia, near Albuñol Village, Granada Province (Spain), at 450 m AMSL (Fig. 1). It is a karstic cave with minimal speleothem development, several stratified prehistoric occupations, and further unstratified objects spanning prehistoric times into the 19th century. The latter materials correspond to the goods deposited in the cave during its use as a burial place in recent history. The importance of the site lies in the fact that it has yielded the oldest and best-preserved organic assemblage of materials in Europe dating from the Mesolithic to the Bronze Age, such as wooden objects and plant and animal fibre-based artefacts, on which this paper is focused (Martínez-Sevilla et al. 2023; Bertin et al. 2024).

The site was discovered in the 19th century and documented by M. de Góngora y Martínez (de Góngora 1868), but until the late 20th century only a few studies focusing on the plant fibre objects found at that time had been published (Alfaro 1984; Cacho et al. 1996). With the launch of the MUTERMUR (De los museos al territorio: Actualizando el estudio de la cueva de los Murciélagos de Albuñol(REF: CM/JIN/2021-009) project in 2021, the site was reassessed by radiocarbon dating and the materials were re-examined after having been stored for almost 150 years in two museums: Museo Arqueológico Nacional (MAN, Madrid) and Museo Arqueológico y Etnográfico de Granada (MAEG, Granada). Recent excavations conducted as part of the MUTERMUR project have brought to light additional extensive archaeological material – both organic and inorganic – that is currently under study.

The MUTERMUR interdisciplinary research project has used advanced archaeometry to gain deeper insights into the site. Techniques such as high-precision radiocarbon dating, Bayesian modelling, microscopic examination and proteomics of perishable materials have been systematically employed. These efforts have significantly improved the chronological framework of the site, revealing a 2000-year gap between the Mesolithic and Neolithic occupations (Martínez-Sevilla et al. 2023). Radiocarbon dating has so far identified three distinct phases of material deposition within the cave (Tab. 1). The earliest, associated with Mesolithic hunter-gatherer groups, dates from around 7500–7000 BC and is characterised by the production of simple

2 López i Bultó 2015; Schoch et al. 2015; Milks 2018; Vidal-Matutano et al. 2021; Vidal-Matutano et al. 2024; Herrero-Otal 2024; among others.

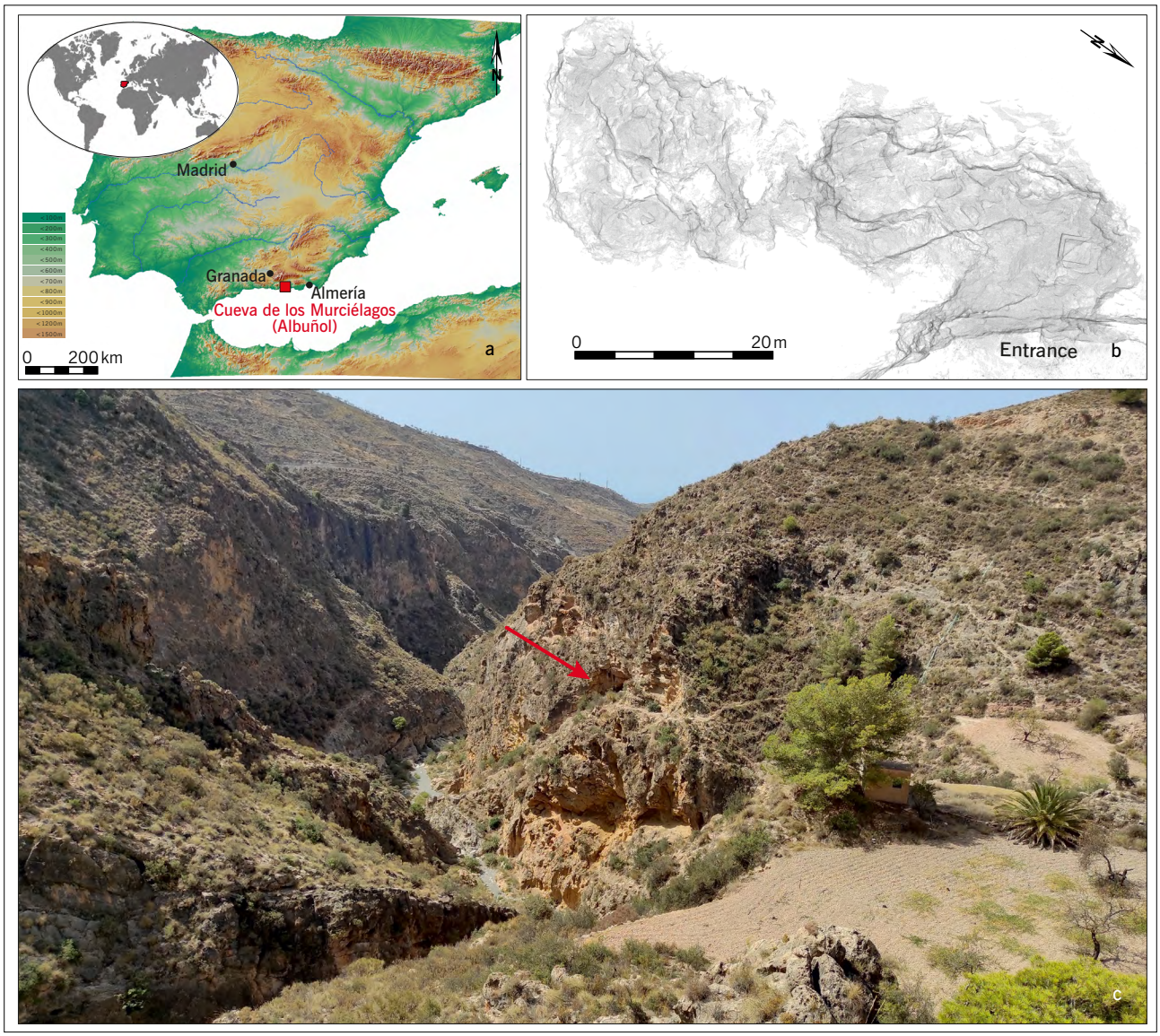


**Fig. 1a–c** The site of Cueva de los Murciélagos: a location of Cueva de los Murciélagos in southeast Spain (Albuñol, Granada, Spain); b plan of the cave made with the 3D model; c view from the north toward the Angosturas gorge and cave entrance (red arrow).

***Abb. 1a–c*** *Der Fundplatz von Cueva de los Murciélagos: a Lage der Cueva de los Murciélagos im Südosten Spaniens (Albuñol, Granada, Spanien); b Plan der Höhle, erstellt aus einem 3D-Modell; c Blick von Norden auf die Angosturas-Schlucht und den Höhleneingang (roter Pfeil).*

twined baskets. The second phase, associated with Neolithic farming communities, dates around 5400–4200 BC. During this period, there was a notable diversification of artefact types, including the use of more diverse techniques involved in raw material processing and basketry (Martínez-Sevilla et al. 2023). Furthermore, a collection of archery artefacts, including sinew bowstrings (Bertin et al. 2024), is also associated with Neolithic groups. The third phase dates to the Bronze Age (1900–1700 BC) and is represented by a wooden shaft.

## The perishable materials

The materials included in this paper are all currently deposited in the MAN and MAEG museums, apart from a twisted cord found during the recent archaeological campaigns developed within the MUTERMUR project.

Basketry elements: The basketry from the cave constitutes the most diverse and extensive assemblage of such items from southern Europe. Different production techniques are well represented, including twining (N = 10) (Fig. 2a–b), rhomboid twining (N = 6), pseudobraiding/*cofín* (N = 6; cf. Fig. 2c), braiding (N = 1; cf. Fig. 2d) and coiling (N = 11; cf. Fig. 2e–e,1). In addition, many of the objects are decorated, either by geometric motifs made of dyed fibres, some of which were studied in the 1990s (Cacho et al. 1996), or by the application of handles reinforced with pieces of animal skin. De Góngora (1868) reported in his publication that some of the baskets preserved diverse contents, such as *Papaver somniferum* capsules in one case and human hair in another. There are also other fibre-based objects of unknown function associated with the site, such as a set of four fibre-linked rings that form a kind of chain.

Fastening elements, cords and sandals: In addition, wooden and cane arrow shafts have been identified among

| Artefact inventory ID | Radiocarbon Lab ID | Objects and technical description | Materials | Raw material taxonomical identification | Anatomical part | Radiocarbon date (BP) | Calibrated radiocarbon dates (BC) | | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1σ | 2σ | |
| CM-MAN581 | Beta-627334 | Simple twined basket | Plant fibres | *Stipa tenacissima* | Leaf | 8300 ± 30 | 7504–7370 | 7531–7353 | Martínez-Sevilla et al. 2023 |
| CM-MAN626 | Beta-628426 | Linked rings | Plant fibres | *Stipa tenacissim*a | Leaf | 8400 ± 30 | 7481–7361 | 7501–7346 | Martínez-Sevilla et al. 2023 |
| CM-MAN579 | Beta-627332 | Simple twined basket | Plant fibres | *Stipa tenacissima* | Leaf | 8350 ± 30 | 7469–7361 | 7487–7332 | Martínez-Sevilla et al. 2023 |
| CM-MAN580 | Beta-627333 | Simple twined basket | Plant fibres | *Stipa tenacissima* | Leaf | 8320 ± 30 | 7464–7356 | 7486–7317 | Martínez-Sevilla et al. 2023 |
| CM-P287 | Beta-684048 | Twisted cord | Animal sinew | *Sus* sp., *Capreolus capreolus* | Sinew | 6220 ± 30 | 5215–2070 | 5290–5045 | Bertin et al. 2024 |
| CM-MAN1139/532 | Beta-692876 | Arrow shaft, Fastening fibres | Plant cane, Animal sinew | *Phragmites australis,* Non-identified | Stem, Sinew | 6220 ± 30 | 5215–2070 | 5290–5045 | Bertin et al. 2024 |
| CM-MAN617 | Beta-627342 | Diagonal twined basket | Plant fibres | *Stipa tenacissim*a | Leaf | 6210 ± 30 | 5156–5067 | 5281–5041 | Martínez-Sevilla et al. 2023 |
| CM-MAN594 | Beta-628427 | Pseudo-braided/*cofín* basket | Plant fibres | *Stipa tenacissima* | Leaf | 6150 ± 30 | 5187–5013 | 5206–5001 | Martínez-Sevilla et al. 2023 |
| CM-MAN1138/532 | Ua-78245 | Arrow shaft, Arrowhead, Fastening fibres | Plant cane, Wood, Animal sinew | *Phragmites australis, Salix* sp., Non-identified | Stem, Twig, Sinew | 6124 ± 30 | 5205–5025 | 5215–4990 | Bertin et al. 2024 |
| CM-MAN591b | Beta-692877 | Twisted cord | Animal sinew | *Capra* sp. | Sinew | 6100 ± 30 | 5055–4950 | 5210–4905 | Bertin et al. 2024 |
| CM-MAN598 | CSIC-1133 | Central core sandal | Plant fibres | *Stipa tenacissima* | Leaf | 6086 ± 45 | 5056–4910 | 5206–4846 | Cacho et al. 1996 |
| CM-MAN609 | CSIC-1134 | Central core sandal | Plant fibres | *Stipa tenacissima* | Leaf | 5900 ± 38 | 4826–4720 | 4886–4691 | Cacho et al. 1996 |
| CM-MAN616 | CSIC-1132 | Coiled basket | Plant fibres | *Stipa tenacissima* | Leaf | 5861 ± 48 | 4795–4680 | 4844–4556 | Cacho et al. 1996 |
| CM-MAN611 | Beta-627331 | Simple twined basket | Plant fibres | *Stipa tenacissim*a | Leaf | 5640 ± 30 | 4533–4406 | 4542–4367 | Martínez-Sevilla et al. 2023 |
| CM-MAN603 | Beta-627330 | Central core sandal | Plant fibres | *Stipa tenacissima* | Leaf | 5630 ± 30 | 4499–4371 | 4537–4366 | Martínez-Sevilla et al. 2023 |
| CM-MAN615 | Beta-627341 | Coiled basket | Plant fibres | *Stipa tenacissima* | Leaf | 5580 ± 30 | 4446–4365 | 4484–4350 | Martínez-Sevilla et al. 2023 |
| CM-MAN623 | Beta-627337 | Pseudo-braided/*cofín* basket | Plant fibres | *Stipa tenacissima* | Leaf | 5570 ± 30 | 4443–4361 | 4454–4348 | Martínez-Sevilla et al. 2023 |
| CM-MAN624 | Beta-627336 | Pseudo-braided/*cofín* basket | Plant fibres | *Stipa tenacissima* | Leaf | 5550 ± 30 | 4443–4351 | 4447–4346 | Martínez-Sevilla et al. 2023 |
| CM-MAN625 | Beta-627335 | Braided basket | Plant fibres | *Stipa tenacissima* | Leaf | 5550 ± 30 | 4443–4351 | 4447–4346 | Martínez-Sevilla et al. 2023 |
| - | CSIC-246 | - | Plant fibres | - | - | 5400 ± 80 | 4438–4262 | 4453–4173 | López 1978 |

**Tab. 1** Technical, raw material identification and unmodelled and modelled radiocarbon dates for the materials from the Cueva de los Murciélagos site included in the current paper.

***Tab. 1*** *Technische Daten, Identifizierung des Rohmaterials und nicht modellierte sowie modellierte Radiokarbondaten für die Materialien aus der Fundstätte Cueva de los Murciélagos, die in der vorliegenden Arbeit berücksichtigt wurden.*

**Fig. 2a–e** Examples of Mesolithic and Early Neolithic baskets from Cueva de los Murciélagos: a Basket CM-MAN579 (7487–7332 cal BC, Beta-627332); b basket CM-MAN581 (7531–7353 cal BC, Beta-627334); c basket CM-MAN594 (5206–5001 cal BC, Beta-628427); d basket CM-MAN625 (4447–4346 cal BC, Beta-627335); e.e,1 basket fragment CM-MAN615 (4484–4350 cal BC, Beta-627341).

***Abb. 2a–e*** *Beispiele für mesolithische und frühneolithische Körbe aus der Cueva de los Murciélagos: a Korb CM-MAN579 (7487–7332 cal BC, Beta-627332); b Korb CM-MAN581 (7531–7353 cal BC, Beta-627334); c Korb CM-MAN594 (5206–5001 cal BC, Beta-628427); d Korb CM-MAN625 (4447–4346 cal BC, Beta-627335); e.e,1 [MH1] Korbfragment CM-MAN615 (4484–4350 cal BC, Beta-627341).*

the organic material assemblage in the two museums, and additional finds have been made during the recent excavations. The ends of some shafts are tightly wrapped with fibres – binding feathers to the shaft in some instances (Fig. 3a–a,1) – or fastening wood and cane together in cases where the shaft combines both materials. The cord assem-

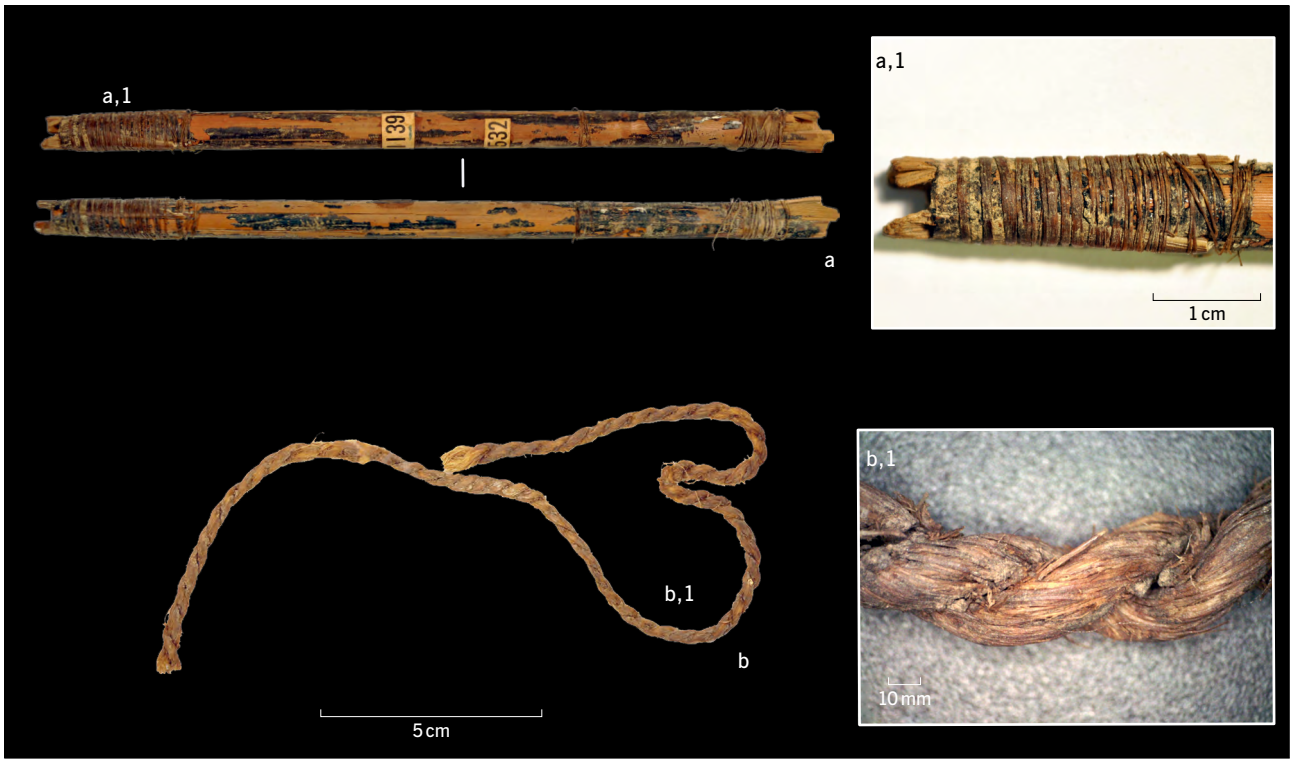


**Fig. 3a–b** Early Neolithic archery elements from Cueva de los Murciélagos: a.a,1 Cane arrow shaft CM-MAN1139/532 (5290–5045 cal BC, Beta-692876); b.b,1 Cord fragment CM-MAN591b (5210–4905 cal BC, Beta-692877).

***Abb. 3a–b*** *Frühneolithische Bogenschießelemente aus Cueva de los Murciélagos: a.a1 [MH2] [MH3] Pfeilschaft aus Schilfrohr [CM4] CM-MAN1139/532 (5290–5045 cal BC, Beta-692876); b.b,1 [MH5] Schnurfragment, identifiziert als mögliche Bogensehne CM-MAN591b (5210–4905 cal BC, Beta-692877).*

blage consists of ten examples; two are twisted cords, one of which is shown in Fig. 3b–b,1 (CM-MAN591b and CM-P287). Some of their characteristics are quite similar; for example, both are two-ply twisted cords (Szz) with closed twist angles (53/55°–60°) and two twists per centimetre. One cord measures 34 cm, the other 59 cm in length. The remaining eight cords are braided (three-ply) and vary in length and width. Some of the cords resemble fastening elements found on sandals recovered at the site. Sandals are an important part of the inventory (Alfaro 1984) distinguished two types of sandals: simple (N = 2; Fig. 4a) and central core (N = 20; Fig. 4b–d), differentiated by the way the sole was made. Notably, the number of sandals available is increasing, as new examples have been recovered in recent archaeological fieldwork. The simple type has no preserved fasteners, while the central core type has a small group of fibres extending from the base of the sole, which may be placed between the first and second toes. These fibres are also connected to a braid attached to the centre of the sandal, which could be tied around the ankle. The footwear shows clear signs of wear on the lower part of the sole.

## Methodology

### Raw materials identification by optical and electronic microscopy

The objects included in this study were recorded in the museums and the laboratory and documented by an extensive photographic record (Nikon D5000 camera with a NIKKOR AF-S DX 18-55 mm VR lens). In addition, detailed images were taken with a portable Dino-Lite Edge digital microscope AM7915MZT (× 20 to × 220).

The materials were sampled using tweezers and a blade, both of which were cleaned with 96 % ethanol between samples to prevent cross-contamination. Although sampling is an inherently destructive process, small fibre fragments, just a few millimetres in size, are required for identification purposes. Due to the fragility of these objects, small pieces often break off during restoration or storage, and in most cases, these fragments were used for sampling to minimise further damage to the objects.

The collected samples were used for microscopic analysis. For optical microscopic (OM) studies, observations were made using an Olympus BX51 transmitted-light bright-dark field microscope (× 50 to × 500), equipped with an Olympus DP26 camera and linked to Olympus cellSens software for imaging and documentation. The OM observations were developed in the Archaeobotany Laboratory of the Prehistory Department at the Universitat Autònoma de Barcelona (UAB). To obtain high-quality images and verify identifications, selected samples were examined using a Zeiss Merlin field emission scanning electron microscope (SEM) at the Servei de Microscòpia i Difracció de Raigs X (UAB). Depending on the availability of the sample, some samples were coated with a 15 nm gold layer using an Emitech K550 sputter coater.

Fibre identification was carried out through a comparative analysis of the microhistological characteristics of the

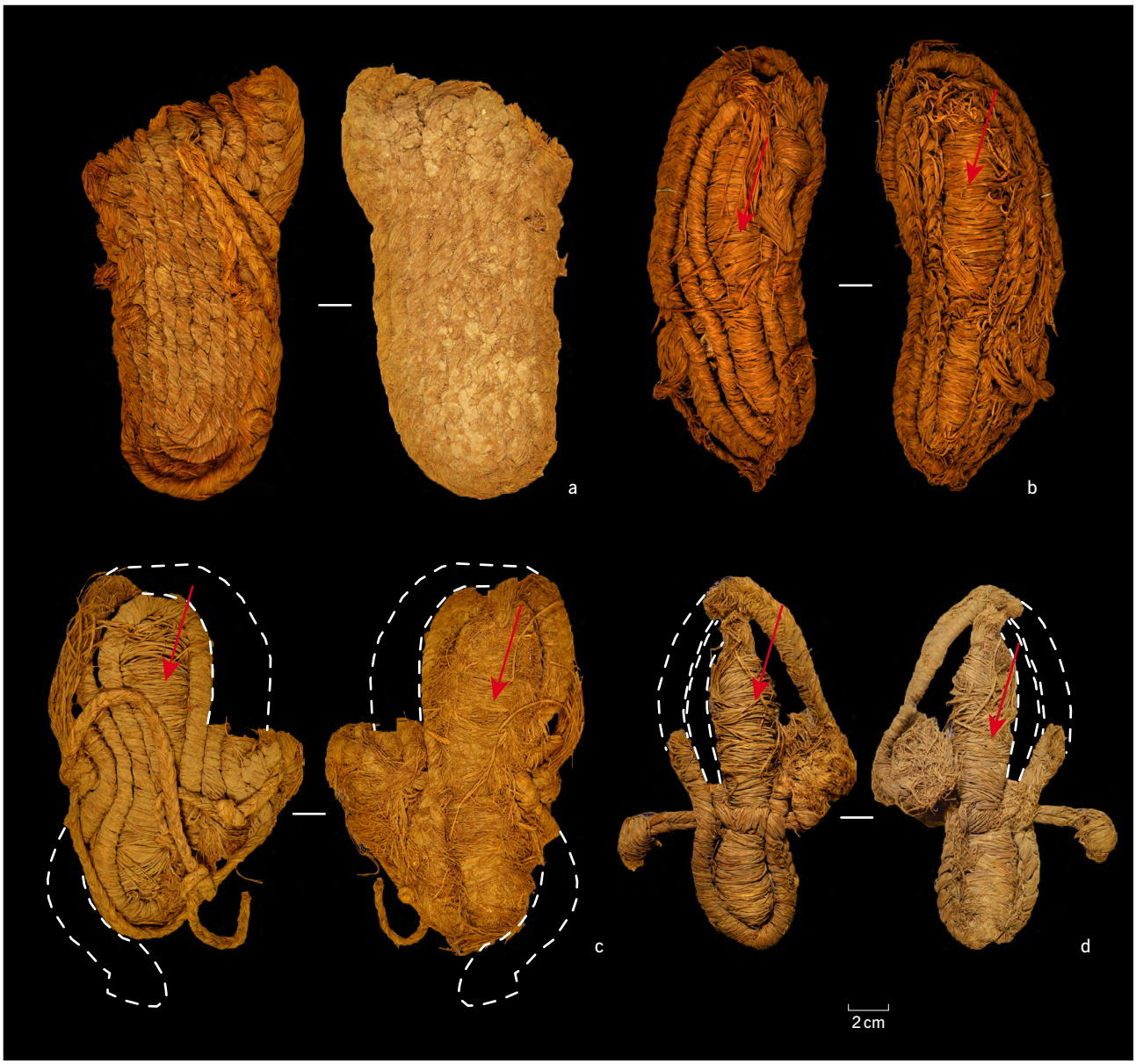


**Fig. 4a–d** Middle Neolithic sandals from Cueva de los Murciélagos: a Sandal CM-MAN603 (4537–4366 cal BC, Beta-627330); b sandal CM-MAN611 (4542–4367 cal BC, Beta-627331); c sandal CM-MAN598 (5206–4846 cal BC, CSIC-1133); d sandal CM-MAN609 (4886–4691 cal BC, CSIC-1134).

***Abb. 4a–d*** *Mittelneolithische Sandalen aus der Cueva de los Murciélagos: a Sandale CM-MAN603 (4537–4366 cal BC, Beta-627330); b Sandale CM-MAN611 (4542–4367 cal BC, Beta-627331); c Sandale CM-MAN598 (5206–4846 cal BC, CSIC-1133); d Sandale CM-MAN609 (4886–4691 cal BC, CSIC-1134).*

archaeological samples and modern reference materials. In the case of plant fibres, the archaeological samples were compared with a reference collection of plants traditionally used for fibre production and found naturally in the vicinity of the site. These included species such as *Stipa tenacissima*, *Stipa gigantea* and *Lygeum spartum*. For sinew samples, the archaeological specimens were compared with modern sinew of horse *(Equus* sp.*)*, deer *(Cervus* sp.*)* and water buffalo *(Bubalus bubalis)*, as traditionally used in modern archery. The modern plant and animal materials used for comparison were prepared using standard techniques. For plant fibres, this involved collecting, drying, moistening and physically processing the plants, while sinew samples were cleaned, dried and stretched. These preparations ensured that the modern materials were suitable for accurate comparative analysis.

## Elemental, spectroscopic and proteomic analysis

**Elemental Analysis:** Elemental analysis was carried out using an EDS Oxford LINCA-X-Max detector (Servei de Microscòpia i Difracció de Raigs X, UAB) at a resolution of 15 kV; to preserve the archaeological samples for possible re-use, they were not coated with carbon. These analyses were carried out on two archaeological samples (twisted cords) and on reference samples of modern animal sinews.

**Spectroscopic Analysis:** The same samples were analysed by Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy using a Perkin Elmer Frontier instrument (Cultures – Environnements. Préhistoire, Antiquité, Moyen Âge [Le CEPAM], Université Côte d'Azur). This non-destructive technique allows the identification of the molecular and compositional properties of the

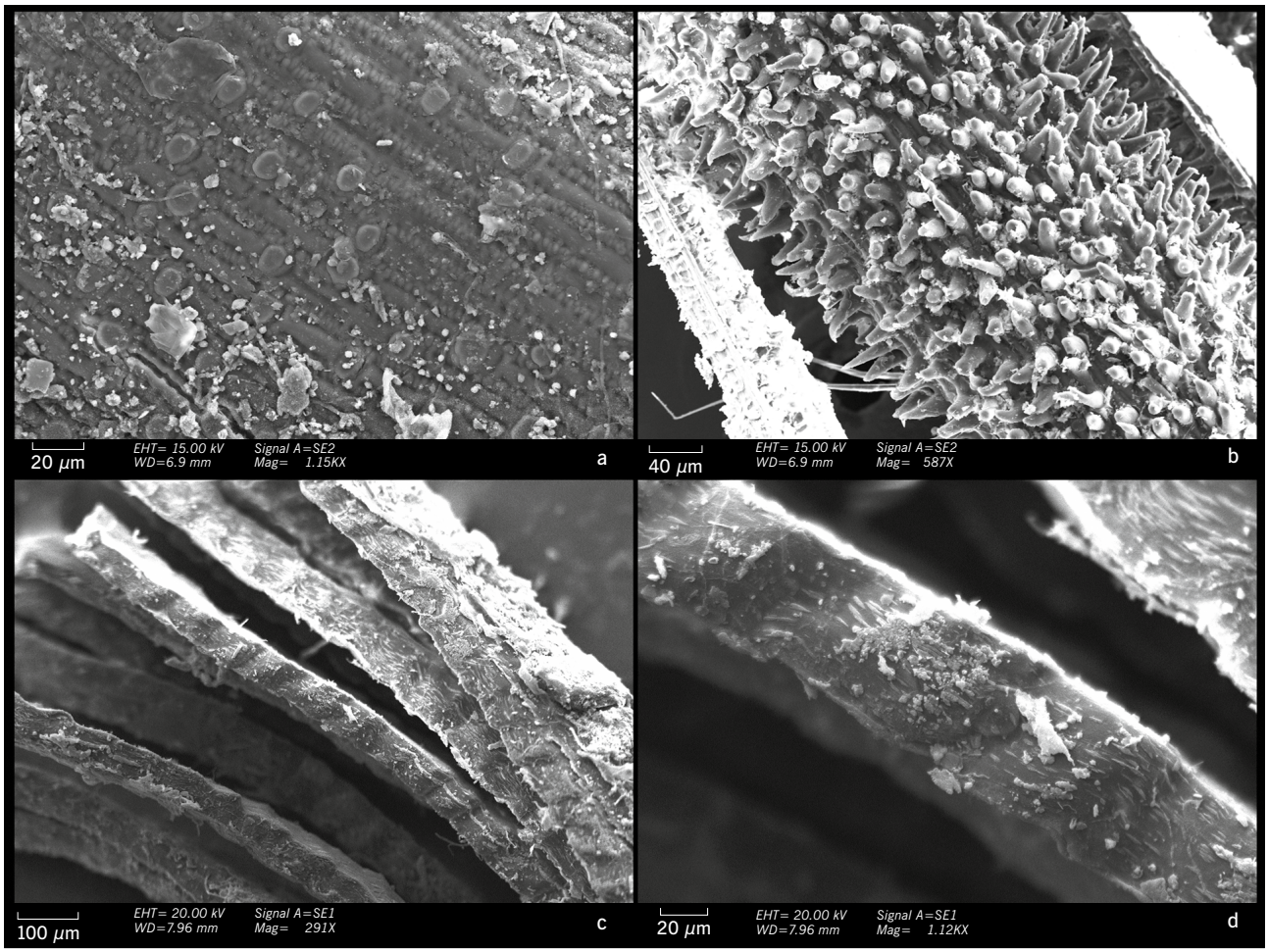


**Fig. 5a–d** Fibre-based objects from Cueva de los Murciélagos SEM images: a Adaxial epidermis of archaeological *Stipa tenacissima* (CM-MAN583); b abaxial epidermis of archaeological *Stipa tenacissima* (CM-MAN583); c–d sinew archaeological sample (CM-MAN591b).

***Abb. 5a–d*** *Faserbasierte Objekte aus der Cueva de los Murciélagos SEM-Bilder: a Adaxiale Epidermis der archäologischen Stipa tenacissima (CM-MAN583); b Abaxiale Epidermis der archäologischen Stipa tenacissima (CM-MAN583); c–d Archäologische Sehnenprobe (CM-MAN591b).*

samples. The spectral data were processed using Spectragryph v1.2.16.1 software and compared with published databases and references (Jung 2000; Monnier et al. 2018).

**Proteomic Analysis:** Based on the findings that the cords were of animal origin, Zooarchaeology by Mass Spectrometry (ZooMS) was used to determine their taxonomic source by analysing the collagen in the samples. Analysis was carried out using a Bruker ultrafleXtreme MALDI-ToF-MS at the CoEMS facility at the University of York. The spectral data were averaged and processed using mMass software (Strohalm et al. 2008) and then compared against established databases of collagen peptide markers (Buckley et al. 2009; Kirby et al. 2013; Welker et al. 2016).

## Results

A thorough analysis of the samples of fibre-based objects and fastening elements from the arrow shafts revealed that all the baskets, braided cords, and footwear were based on plants, while the twisted cords and fasteners on the shafts were of animal origin.

With regard to plant fibre-based materials (baskets, braided cords and footwear), all samples confirmed the use of esparto grass *(Stipa tenacissima)*. Microscopic examination revealed distinct microanatomical features characteristic of modern esparto grass (Fig. 5a–b) that were not observed in other *Poaceae* plants with esparto-like properties, such as *Stipa gigantea* and *Lygeum spartum*.

In certain objects, variations in the treatment of fibres were visible to the naked eye. Physical treatments such as crushing can be easily identified by direct observation or histological analysis, whereas processes such as retting and fermentation are not visible. Fibre treatments varied according to the craft techniques used throughout the assemblage. Both raw and crushed esparto were used in basketry. Raw esparto was mainly used for objects made using twining and braiding. Pseudobraiding was also made primarily from raw esparto, with one exception. Coiling baskets used both types of processed esparto: raw esparto formed the bundles, while the stitches showed signs of opened fibres, indicating that the leaves had been crushed. The braided cords were made with crushed fibres, as were both types of sandals. In addition, the selection of leaves according to size was evi-

dent. The smaller diameter of the esparto leaves used in Mesolithic objects compared to those from the Neolithic suggests that younger leaves were selected for manufacturing Mesolithic artefacts than those made in the Neolithic period.

In contrast, observations made under an OM on two twisted cords and the fastening elements from the arrow shaft samples revealed no plant characteristics, suggesting an animal origin. These materials were then examined using an SEM. This high magnification examination of the two twisted cord samples revealed parallel fibres running along their length, with a hierarchical structure with wavy fibres (cf. Figure 5c–d) very similar to that of collagen-rich animal tissue. While the results for the cords were good, as the characteristics of the raw material were clearly visible, this was not the case for the shaft fasteners, as the presence of an unidentified substance (perhaps an adhesive like birch tar) made observation more difficult.

Nevertheless, elemental analysis confirmed an animal origin. FTIR spectroscopy performed on both the tendons and the ligaments revealed that the material was composed of collagen, the main component of connective tissue. Further comparison with modern sinew confirmed the identification as sinew. ZooMS was carried out on small samples from each cord to identify the animal from which it came. The analysis showed that sample CM-MAN-591b was from *Capra* sp. (goat), while sample CM-P287 was composed of several species, including *Sus* sp. (pig) and *Capreolus capreolus* (roe deer).

## Discussion

### Material diversity and functional specialisation

Prehistoric communities in the Cueva de los Murciélagos site employed a variety of material selection and processing strategies. The predominant use of *Stipa tenacissima* for the production of baskets, sandals, and other fibre-based goods has been documented (Martínez-Sevilla et al. 2023), demonstrating a systematic approach to the processing of esparto, depending on the type of objects that should be produced, the technique used to fashion them, and their function. In addition, I. Bertin et al. (2024) highlight the choice of materials for the construction of archery equipment, identifying the use of animal sinew -goat, pig and roe deer- for bowstrings, as well as willow *(Salix* sp.*)*, olive wood *(Olea europaea)*, maple *(Acer* sp.*)*, and a variety of reed *(Phragmites* sp.*)* for arrow shafts.

The selection of these materials reflects an advanced understanding of their mechanical properties. Both studies underline a deep understanding of the structural properties of raw materials and their suitability for meeting specific functional requirements.

### Technological continuity and crafts

From a technological and functional point of view, the results of our studies underline a technological continuity across different craft domains. On the one hand, a long-term transmission of fibre-based craft knowledge is observed, as crafts such as basketry have been transmitted and refined over millennia. On the other, the results demonstrate a dynamic process of innovation within these prehistoric communities. By integrating new techniques, Neolithic populations in southern Iberia demonstrated remarkable adaptability in material use, both plant and animal, and in technological development.

### Environmental adaptation and resource management

The systematic analysis of the fibres used as raw material at the Cueva de los Murciélagos site confirmed the use of *Stipa tenacissima* for craft purposes (Martínez-Sevilla et al. 2023). The use of this species was suggested by previous studies through macroscopical observation (Alfaro 1984). In the current study, microscopic examination revealed microanatomical characteristics visible in modern esparto samples that are absent in other plants of the *Poaceae* family with esparto-like properties. Although palynological studies (Revelles 2023) suggest that other hydrophytic plants should have been present relatively close to the cave, no other plants were found in the analysis of fibre-based products from the site, suggesting that the Mesolithic and Neolithic human groups that occupied or used the cave relied on the natural resources available locally.

Esparto grass is still used today in traditional crafts, and its use goes back to prehistory, as shown by the materials studied here. However, these are not the oldest remains found in Iberia. The oldest direct evidence of the use of esparto grass discovered to date was found at Coves de Santa Maira, Alacant Province, Spain (9600 ± 40–7370 ± 40 cal BC), where three charred fragments of braided cord and an untwisted fibre of this material were documented (Aura-Tortosa et al. 2019). However, some other archaeological examples have provided evidence of its use, largely thanks to the arid preservation conditions that prevail across much of the peninsula. On the east coast, fragments of a woven basket made of esparto grass have been found at Cova de les Cendres, Alacant Province, Spain (4510 ± 40 cal BC; Bernabeu/Fumanal 2009). However, the majority of finds are from southern Iberia and date to more recent periods: remains of a plaited cord at Villa Filomena, Valencian Community, Spain (3000–1800 cal BC), fragments of cords and plaited baskets at Cabezo Redondo, Alacant Province, Spain (2429–2065 cal BC), braided cords and plaited, twisted and coiled baskets at Ifré, Almería Province, Spain (2360–1910 cal BC; Alfaro 1984), a braided cord and remains of woven baskets at Las Angosturas de Gor, Province of Granada, Spain (2350–1919 cal BC; Cacho et al. 1996), and a corded net documented at Castellón Alto, Province of Granada, Spain (1900–1600 cal BC; Molina et al. 2003).

Different hypotheses for the use of birch bark tar in the production of arrow shafts can be proposed, including adhesive, decorative and structural consolidation purposes. These hypotheses are supported by archaeological evidence (Desmond Clark et al. 1974) and ethnoarchaeological studies (Šmit 2016) that document the use of adhesives and paintings on arrows, or birch bark tar used similarly on other wooden artefacts (Kabaciński et al. 2023; Koch et al. 2024).

The efficient use of locally available materials reflects not only a deep understanding of the local ecosystem but also an ability to adapt technological practices to specific environmental conditions. This has also been suggested in other contemporary sites in the northeastern part of the Iberian Peninsula, such as La Draga, where an extensive collection of wooden (López i Bultó 2015; Piqué et al. 2021) and plant fibre-based objects has been recorded[3], indicating a sophisticated technological and environmental knowledge of Neolithic communities in the management and use of plant resources.

## Conclusions

The natural drying conditions of the Cueva de los Murciélagos site played a crucial role in the preservation of organic materials, providing a rare and valuable window into the daily life and technological innovations of its prehistoric inhabitants. The multidisciplinary research developed under the MUTERMUR project highlights the complexity of prehistoric technological systems. The integration of plant and animal-based materials, together with advanced manufacturing techniques, demonstrates the remarkable technological expertise of human communities dating back at least to the Mesolithic when subsistence patterns were based on hunting and gathering. These technological skills expanded over time, particularly in the use of plant fibres and animal sinew, which were probably applied to activities related to both hunting and agriculture as early farming practices emerged in southern Iberia (Martínez-Sevilla et al. 2023; Bertin et al. 2024).

Future research involving experimental archaeology and further biomolecular analysis could improve our understanding of the specific functional properties of these materials and their wider implications for Neolithic social organisation, technological progress and the transmission of cultural knowledge.

## Acknowledgements

This research has been carried out within the framework of different research projects: »De los museos al territorio: actualizando el estudio de la Cueva de los Murciélagos de Albuñol (Granada)« (MUTERMUR; Ref. CM/JIN/2021-009, IP: Francisco Martínez-Sevilla) and »La Cueva de los Murciélagos de Albuñol una ventana única a la Prehistoria del sur de Europa« (MUTERMUR 2.0; Ref. CM/DEMG/2024-046, IP: Francisco Martínez-Sevilla) financed by Comunidad de Madrid and Universidad de Alcalá and »The organic chemistry and molecular biology of archaeological artefacts« funded by the European Union's Horizon 2020 research and innovation programme under ChemArch grant agreement N. 956351 (Ingrid Bertin as beneficiary). Raquel Piqué is ICREA Academia researcher and, Maria Herrero-Otal, Ingrid Bertin and Raquel Piqué member of the research group TEDAS 2021-SGR 00190 funded by the AGAUR. The fieldworks at the site during the years 2022–2023 has had permission from Delegación Territorial de la Junta de Andalucía de Cultura y Patrimonio Histórico de Granada (EXP: BC.03.143/22 14100 and EXP: BC.03.136/23 15490).

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## Source of figures

All the figures were taken and laid out by the authors of the paper, who are part of the MUTERMUR project: Maria Herrero-Otal, Ingrid Bertin, Francisco Martínez-Sevilla.

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# Textiles and textile production at the Neolithic site of La Marmotta, Anguillara Sabazia, Lazio (Italy)

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**Zusammenfassung**

Textilien und Textilproduktion in der neolithischen Fundstätte von La Marmotta, Anguillara Sabazia, Latium (Italien)

*Die Möglichkeit, an archäologischen Stätten selten erhaltene Materialien zu untersuchen, ergibt sich nur in Ausnahmefällen. Ein solcher Fall ist die frühneolithische Fundstätte von La Marmotta, Anguillara Sabazia, Latium (Italien). Ihre Entdeckung unter Wasser im Braccianosee hat ein Fenster in die Vergangenheit geöffnet. Die Quantität und Qualität der Überreste, die während der Ausgrabungen über fast zwei Jahrzehnte hinweg dokumentiert wurden, sind herausragend. Bei einigen dieser Überreste handelt es sich um Fragmente von Textilien, Tauwerk und Korbwaren sowie um Werkzeuge aus Holz, Knochen und Stein, die wahrscheinlich mit deren Herstellung in Verbindung stehen. Die vorliegende Übersicht über diese Objekte zielt darauf ab, die technischen Prozesse und die* Chaîne opératoire *bei der Herstellung von Textilien zu bestimmen. Dies ist umso wichtiger, als aufgrund der Seltenheit an ethnografischen und archäologischen Parallelen keine Anhaltspunkte bekannt sind, die Aufschluss darüber geben könnten, wie Holzwerkzeuge in die Textilherstellung eingebunden waren. Die hier vorgestellten Vorschläge müssen jedoch möglicherweise überarbeitet werden, sobald mehr Informationen verfügbar sind.*

**Schagwörter** Textilien, Korbwaren, Tauwerk, Frühneolithikum, Mittelmeerraum

**Summary**

*The opportunity to study materials rarely preserved at archaeological sites arises only in exceptional cases. One such case is the Early Neolithic site of La Marmotta, Anguillara Sabazia, Lazio (Italy). Its discovery under the waters of Lake Bracciano has opened a window to the past. The quantity and quality of the remains – documented during excavation over nearly two decades – are outstanding. Some of these remains are fragments of cloth textiles, cordage and basketry, as well as wooden, bone and stone implements probably linked to their manufacture. The present overview of these objects aims to determine the technical processes and the* chaîne opératoire *involved in producing textiles. This is even more important as the scarcity of ethnographic and archaeological parallels means that no points of reference are known that could illuminate how wooden tools were involved in textile manufacture. However, the proposals presented here may require some revision as more information becomes available.*

**Keywords** Textiles, basketry, cordage, Early Neolithic, Mediterranean area

## Introduction

The importance of plant and animal resources used to produce textiles, baskets and cordage in prehistory is inversely proportional to their appearance at archaeological sites. The effect of taphonomic processes has usually deprived us of those types of artefacts whose study, with ethnographic information as a point of reference, would provide important data about past societies: their ways of life, their technology, their knowledge of the environment, their relationship with other communities and, in general, the economic, social and symbolic significance and value of the objects. Only in environments of extreme cold or heat and waterlogged or arid contexts has the reduction of oxygen and bacteria enabled the preservation of this type of material (Ballmer et al. 2025).

Consequently, remains of textiles, cordage, and basketry are found only at a few prehistoric localities. Some of the earliest evidence comes from Palaeolithic and Mesolithic sites, such as Dzudzuana Cave, Chiatura, Imereti region (Georgia), where remains of linen fibre dated between 36 000 and 13 000 (cal.) years ago were found (Kvavadze et al. 2009), Ohalo II, Northern district (Israel), where 2–3 mm fibre fragments were interpreted as remains of cordage made from monocotyledon plants around 19 000 years ago (Nadel et al. 1994), as well as at Tybrind Vig, Region of Southern Denmark (Denmark; 7400–6000 cal. BP), and Zamostje 2, Moscow Oblast (Russia; c. 8200 cal. BP), where waterlogged conditions allowed the preservation of cord used to make fishing nets and traps, bows, arrows, and ornaments (Fischer 1985; Lozovski/Lozovskaya 2016). In the western Mediterranean, the most

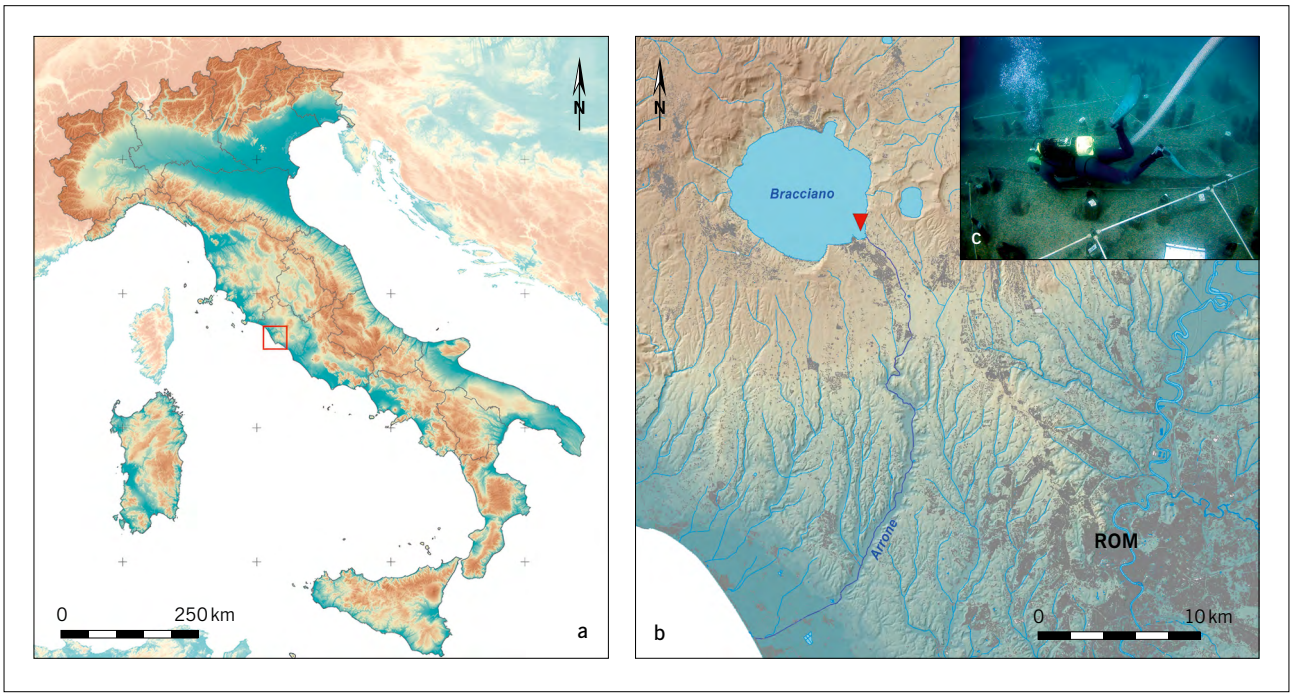


**Fig. 1a–c** a Location of the settlement of La Marmotta, Anguillara Sabazia, Lazio (Italy); c Lake Bracciano; d photograph of the underwater excavation.

***Abb. 1a–c*** *a Lage der Siedlung von La Marmotta, Anguillara Sabazia, Latium (Italien); b Lago di Bracciano; c Foto der Unterwasserausgrabung.*

spectacular case is Cueva de los Murciélagos in Albuñol, Prov. Granada (Spain). While some baskets date to the Mesolithic period (c. 8400–8300 cal. BP), other baskets, ropes, and sandals correspond to the Neolithic period (6210–5550 cal. BP; Martínez-Sevilla et al. 2023).

At some of the earliest Neolithic sites, arid or wet conditions were the factors that allowed the conservation of these types of materials. In the Near East, at the mortuary cave of Nahal Hemar, Southern district (Israel), fragments of ropes and baskets made of rushes, reeds, and flax (*Phragmites australis, Juncus*, and *Linum usitatissimum*) were dated to 9900 cal. BP (Schick 1986; Shamir 2020). At Çatalhöyük, Prov. Konya (Turkey), evidence of fabrics and basketry is also related to mortuary spaces with an age of c. 7500–7000 cal. BP (Marciniak et al. 2015). In Europe, a large number of remains of cordages, textiles, and baskets have been found at Charavines, on Lake Paladru, Dep. Isère (France; c. 6000 cal. BP), at Arbon-Bleiche 3, canton of Thurgau (Switzerland), next to Lake Constance (c. 5400–5300 cal. BP), at Egolzwil, canton of Lucerne (Switzerland), located on the former Lake Wauwilermoos (c. 6200 cal. BP), which was drained in 1865, at La Draga, Lake Banyoles, Prov. Girona (Spain; c. 6300–6000 cal. BP), or at Cova dels Fems, Prov. Tarragona (Spain; c. 5970–5770 cal. BP)[1].

This summary of archaeological evidence cannot overlook ›Ötzi‹, the Iceman (c. 5300 cal. BP). Found high in the Alps, many items of his equipment were made of lime bast: the dagger sheath, cords, a knotted net of twined strings, and the inner nets of his three-part shoes (Spindler 1995).

## Objectives: the Neolithic settlement of La Marmotta

The Neolithic site of La Marmotta is located under the waters of Lake Bracciano, Anguillara Sabazia, Lazio (Italy). It was excavated from 1992 to 2006 under the supervision of M. A. Fugazzola and the Soprintendenza of the Museo delle Civiltà (Pigorini) (Fugazzola et al. 1993), followed by a final excavation season in 2009 (Fig. 1). The preserved archaeological surface lies about 300 m from the modern shoreline, submerged at a depth of 11 m (8 m of water and 3 m of sediment), which has permitted exceptionally good preservation. The $^{14}C$ dates obtained from the remains of charcoal and seeds and the dendrochronological analyses of the wooden piles supporting the houses indicate that the site was in use between approximately 5700 and 5150 cal. BC (Fugazzola/Tinazzi 2010; Mazzucco et al. 2022; Mineo et al. 2023a).

During the excavation, 3400 piles supporting the dwelling structures were found, as well as the remains of the walls, made from wattle and daub, the roofs, thatched with plant remains, and some wooden floors, made of timber or bark. A total of 14 possible rectangular dwellings (8 to 10 m long and 6 m wide) with internal walls and central hearths have been defined.

La Marmotta was based on a consolidated domestic economy in which several animal and plant species were consumed: goats, sheep, cattle, pigs, wheat, barley, and legumes (lentils, broad beans and peas). Although most of the animal (75 %) and plant (65 %) species were domestic, the popula-

1 Vogt 1951; Médard 2003; Romero et al. 2021a; Romero et al. 2021b.

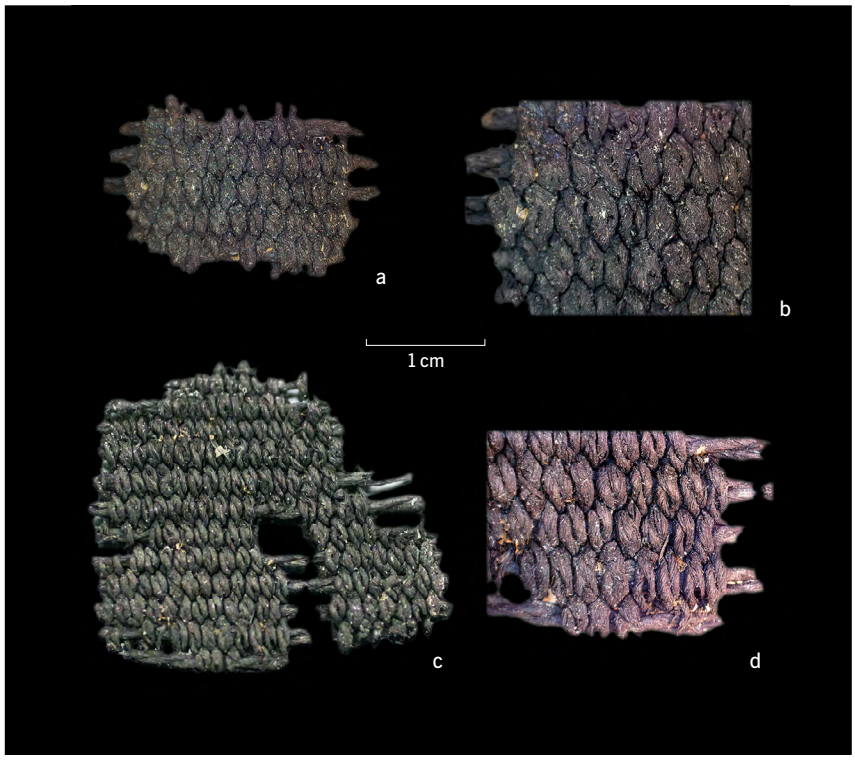


**Fig. 2a–d** Textile fragments found at La Marmotta. Detail of the interlacing used in its elaboration. Fragment c has a perforation.

***Abb. 2a–d*** *In La Marmotta gefundene Textilfragmente. Detail der Verflechtungen, die bei der Herstellung verwendet wurden. Fragment c besitzt eine Perforation.*

tion of La Marmotta also made use of wild resources, such as red deer, wild goats, rabbits, foxes, and different types of fruit (hazelnuts, grapes, sloes and figs). Some plant species were used for other purposes: opium poppy *(Papaver somniferum)* for medical purposes or for its psychotropic effects and flax *(Linum usatissimum)* used to make cloth, together with many other plants, including *Carthamus lanatus, Silybum marianum, Hypericum perforatum, Phragmites australis, Persicaria maculosa, Prunus spinosa,* and *Sambucus* spp. (Rottoli 1993; Rottoli 2002).

The excellent preservation of biotic substances in anaerobic conditions has also allowed the discovery of numerous objects made of wood, such as bows, mattocks, sickles, spoons, and vessels. These are complemented by more than 12 000 lithic tools made from flint and obsidian, numerous axes, adzes and querns, and an array of bone tools (Fugazzola et al. 1993; Mineo et al. 2023a).

## Textiles and manufacturing tools

Owing to the large number of objects and implements possibly related to the production of textiles, cords, and baskets, each category will be described briefly. The reappraisal of the available information and remains stored in the Museo delle Civiltà means that data published in the past must be updated, including tools that had not previously been associated with cloth-making (Mineo et al. 2023a; Mineo et al. 2023b).

## Textiles

Some of the most significant finds are four textile fragments (Fig. 2) discovered in 1995. Their dimensions are relatively small: No. 1, 11.01 mm; No. 2, 27.09 mm (there is a probable hole in it); No. 3, 11.50 mm; and No. 4, 12.92 mm. These well-preserved remains show the broad knowledge acquired by the inhabitants of La Marmotta for the manufacture of textiles and basketry. Scanning electron microscope (SEM) analysis indicated that the textile fragments are made of cellulosic bast fibres (Mineo et al. 2023a).

## Cordage

A total of 29 fragments of cordage of different thicknesses and lengths was found. Their different dimensions would be related to their uses: strings for bows or nets to obtain food, twine to bind implements, such as stone blades, to wooden shafts, and ropes for suspending objects or for use in house construction, among others (Fig. 3). The length and thickness of the cords vary considerably, depending on their original size and the degree of preservation. Thus, both short fragments, a few centimetres long, and a bundle of cord, whose length cannot be calculated because it is coiled up, have been documented. Although information about the types of plants used to make them is still quite limited, initial analyses have identified plants from the *Poaceae* (or *Gramineae*) family of monocotyledonous flowering plants (grasses) (Mineo et al. 2023a) and flax fibres (*Linum* sp.)[2].

2 Pers. commun. Maria Rita Giuliani and Giulia Gaietta, ISCR Biological Research Laboratory.

**Fig. 3a–b** a Bundle of cord; b string, both found at La Marmotta. These two photographs show the state of preservation of the cords and strings.

***Abb. 3a–b*** *a Kordelbündel; b Schnur, beide gefunden in La Marmotta. Diese beiden Aufnahmen zeigen den Erhaltungszustand der Kordeln und Schnüre.*

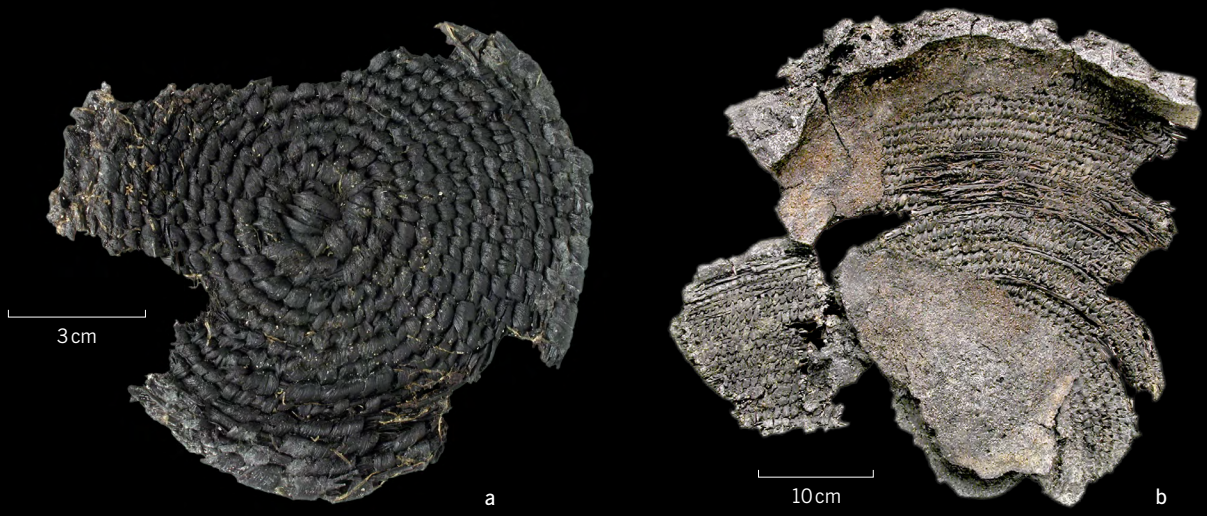


**Fig. 4a–b** Examples of basketry found at La Marmotta. a base of a basket; b bottom of a basket to which food remains still adhere.

***Abb. 4a–b*** *Beispiele für Korbwaren, die in La Marmotta gefunden wurden. a Boden eines Korbes; b Boden eines Korbes, an dem noch Essensreste haften.*

## Basketry

Baskets could be used for various purposes: gathering and processing food, as well as storing and transporting products. Among the 49 remains of baskets at La Marmotta, several techniques have been identified, from weaving and pseudo-weaving to sewn spirals and binding (Fig. 4; Mineo 2019). The most common technique is weaving in concentric spiral circles using the method of ›continuous growth‹. The spiral begins with a bundle of rigid material around which straw is wound and stitched together, probably using a bone needle. In some cases, as shown in Fig. 4b, food remains are still preserved at the bottom of the basket. The preservation of the remains varies greatly, from small pieces to large fragments belonging to the walls or bases of the containers.

## Brushes

Two small brushes were discovered in La Marmotta. The first (Number 14398, Level II, Square D142) consists of a bundle of plant stems (the species has not yet been determined) tied by string in their proximal and medial parts (Fig. 5). While the string in the proximal part creates a rounded shape that would be held in the hand, the one in the middle holds together the active part of the brush. It is 141 mm long and 39.5 mm wide. The two strings have a similar width, between 4.9 and 4.0 mm.

The second brush (Number 22232, Level I, Square A132) is quite similar. It also consists of a bundle of plant stems, tied only in the middle by a string that wraps around the stems three times. The stems are folded over in the mid-

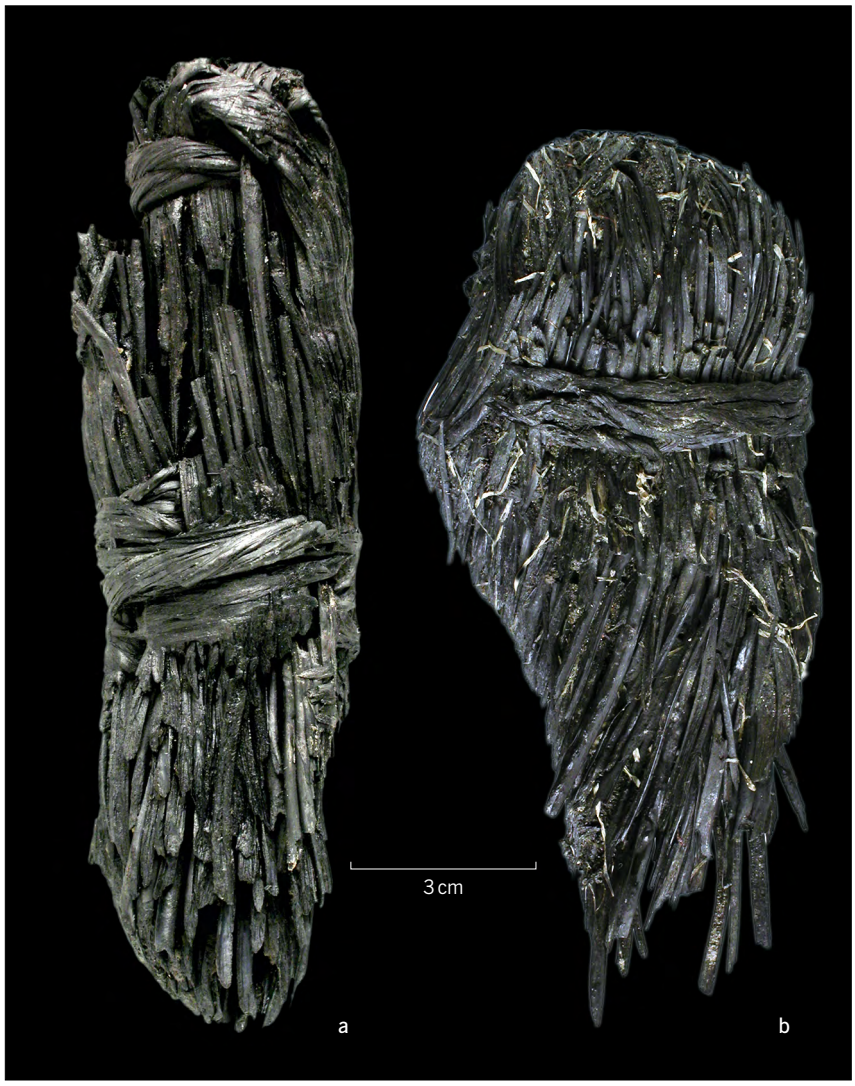


**Fig. 5a–b** Brushes found at La Marmotta. They have a similar morphology and both are tied with cords at one end.

***Abb. 5a–b*** *In La Marmotta gefundene Besen. Sie haben eine ähnliche Struktur und sind beide an einem Ende mit Schnüren gebunden.*

dle and secured with the string, forming a brush with a rounded proximal part and the loose ends of the stems in the active part. It is 124 mm long and 54 mm wide. At its broadest, the string is about 5 mm wide.

## Tools for textile production

### Spindles

The spindles found at La Marmotta would have been used to spin thread. The central part is a small piece of wood, slightly conical in shape and pointed at the ends. Nine examples have been documented, one complete and eight fragments with or without the remains of thread (Fig. 6).

One of the best-preserved specimens is number 6762 (level I, square D299–D250). With a length of 256 mm and a width of 35 mm, it is a cylindrical piece of wood with thread wound around in a biconical shape. It demonstrates the technical ability of the first Neolithic communities in the production of textiles. These are exceptional objects because few similar objects are known from European prehistory. However, some spindles with a different morphology have been found at sites such as Fiavé, Trentino (Italy; Bronze Age) (Perini 1987; Bazzanella et al. 2003).

### Spindle whorls and loom weights

Spindle whorls and loom weights are objects commonly associated with textile production (Rast-Eicher 2005; Forte/Lemorini 2017). During the study of the archaeological material excavated at the site of La Marmotta, 81 weights and 3 spindle whorls were identified (Fig. 7).

The spindle whorls are biconical in shape with a length range of 28–31 mm and a weight range of 3.6–3.8 g, while the diameter of the central vertical hole measures 5 mm in each. A horizontal polished area above the rim of the hole suggests prolonged use caused by repeated contact between the whorl and the spindle (Forte/Lemorini 2017). The loom weights vary more in size and shape than the whorls. They include tube-shaped and cylindrical weights (long and short shapes, respectively) with a round longitudinal hole, circular flat weights with a transversal hole, and a group of varied shapes (triangular, trapezoidal, rhomboid morphologies) with a transversal hole. Their weights range from a minimum of 0.9 g to a maximum of 29 g.

**Fig. 6a–b** Spindles from La Marmotta. a the best preserved spindle from La Marmotta; b a fragment of spindle that has lost part of the cord and the wood inside is very deteriorated.

***Abb. 6a–b*** *Spindeln aus La Marmotta. a Die am besten erhaltene Spindel aus La Marmotta; b ein Spindelfragment, das einen Teil der Schnur verloren hat und dessen Holz im Inneren stark beschädigt ist.*

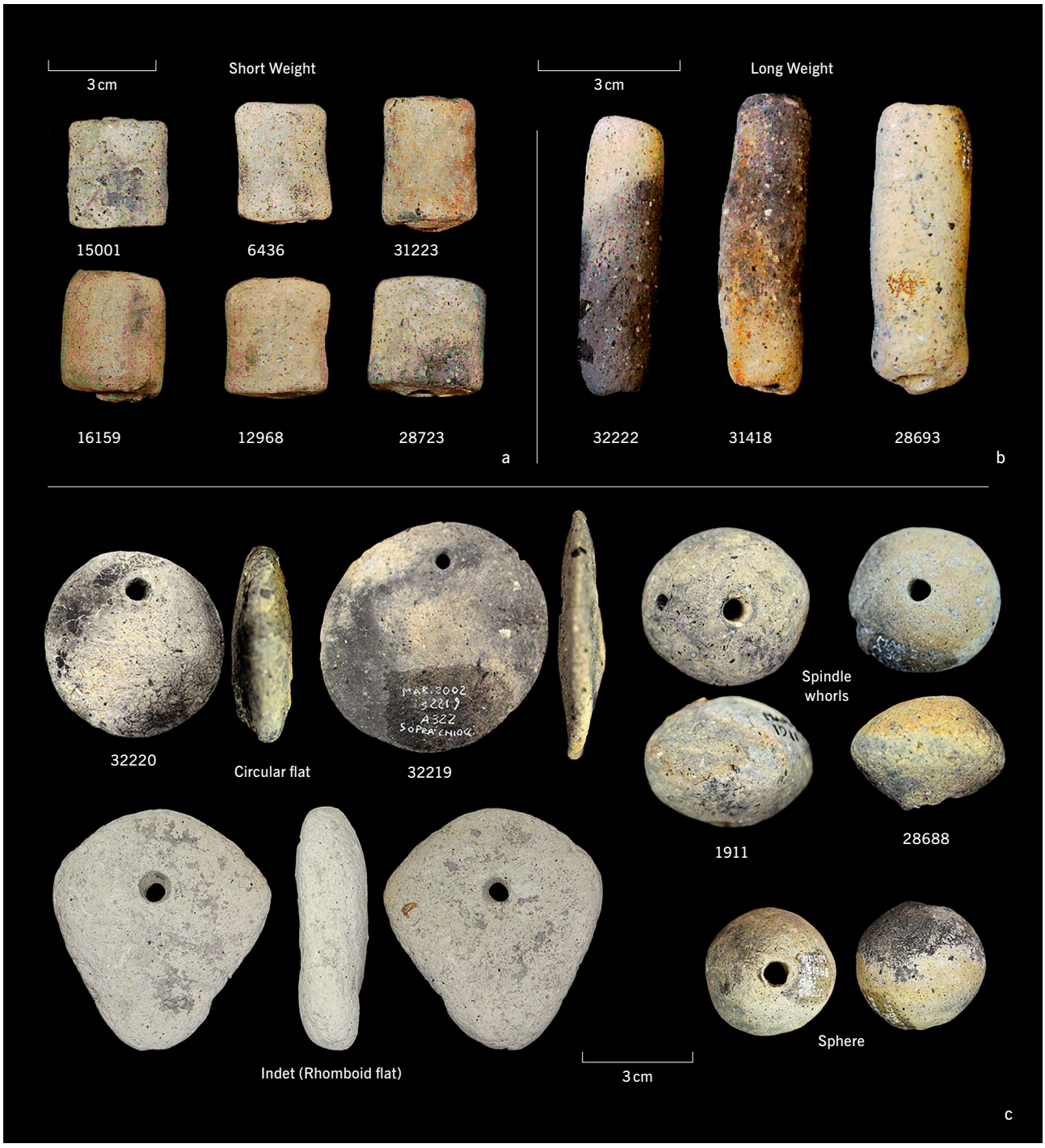

**Fig. 8a–c** Weaving swords found at La Marmotta. Size and preservation are varied. Piece a and c are complete with the handle at one end.

***Abb. 8a–c*** *Webschwerter, gefunden in La Marmotta. Die Größen und Erhaltungen sind unterschiedlich. Die Stücke a und c sind vollständig mit dem Griff an einem Ende erhalten.*

The position of use-wear in specific places around the holes could suggest the use of suspended weights, as in the case of looms. Nevertheless, the peculiar shape of the tubular weights, along with the lack of localised use-wear around the hole, could even suggest the use of these weights as net sinkers. Similar clay weights were used by the Islamic populations in the Iberian Peninsula in the 8th century AD (Merino 1986).

## Weaving swords

Some of the most exceptional wooden tools found at La Marmotta are the weaving swords. 42 complete or fragmented examples of weaving swords have been documented. From a morphological viewpoint, they are all very similar: a long, narrow spatulate form with a sharp side and lenticular cross-section. One of the ends is always narrower, creating a handle; in fact, the handle surfaces have been smoothed, perhaps by hand contact. These handles sometimes end in a pommel, enabling the user to hold the tool more easily. The completely preserved weaving swords are sometimes considerably larger, up to 1340 mm long, 73 mm wide, and 14 mm thick (Fig. 8).

Communities that used traditional looms employed long wooden tools to press down each row of the woven weft. In the 20th century in northern Italy, an instrument like a wooden knife was used to work the textiles (Scheuermeier 1980). However, this interpretation should be accepted with caution because those looms imply a much more complex and advanced technology than is assumed for the Neolithic period. Similar objects have been discovered at other waterlogged sites, albeit of later chronology. For example, weaving swords have been cited at locations in Switzerland (Greifensee, canton of Zurich, Niederwil-Egelsee, canton of Thurgau, and Wetzikon-Robenhausen, canton of Zurich), Italy (Fiavé)

**Fig. 7a–c (left page)** Spindle-whorls and loom-weights used in weaving. All made of clay, they have different forms and weights. They could have been used for different activities.

***Abb. 7a–c (linke Seite)*** *Spinnwirtel und Gewichte, die beim Weben verwendet wurden. Alle sind aus Ton gefertigt und haben unterschiedliche Formen und Gewichte. Sie könnten für verschiedene Arbeiten verwendet worden sein.*

**Fig. 9a–c** Three of the best-preserved *draghetti* from La Marmotta. They all have the same morphology with a perforation in the handle.

***Abb. 9a–c*** *Drei der am besten erhaltenen nicht genau definierten Holzgeräte* (draghetti) *aus La Marmotta. Sie haben alle die gleiche Gestalt mit einer Perforation im Griff.*

and China (Tianluoshan, Prov. Zhejiang) (Bazzanella et al. 2003; Cameron/Guoping 2022).

## Draghetti

Other, rather enigmatic, wooden tools are the *draghetti* (so-called because their toothed shape resembles a dragon's back). In total, seven complete or fragmented *draghetti* have been documented at La Marmotta. They all display the same morphological characteristics (Fig. 9). They are composed of two parts, one straight and the other curved. The former is a straight, broad, perforated handle. The latter forms a concave inner surface and a convex outer face with a line of triangular teeth. The curved active part of the *draghetti* display two very different surfaces: the internal concave surface is smooth and worn by use, while the external convex face displays a series of aligned triangular teeth, some with longitudinal striations and distinct rounding, also probably caused by use.

Although the completely preserved specimens are between 230 and 255 mm long, one of the broken examples (Number 12240, Level I, Square D241) must have been much larger: it is 245 mm long despite missing much of its distal end. The proximal parts of these tools are between 48 and 65 mm wide, while their convex distal parts vary from 55 or 65 mm in their widest section to 20 or 30 mm near the pointed end. The proximal parts are 11–16 mm thick, and the distal parts 22–28 mm thick.

Rather similar objects have been found at the Neolithic waterlogged site of La Draga. The difference is that while some of the items found there do not possess the toothed convex part (in the case of objects No. 35 and 85), others seem to display some teeth (No. 37 and 86; Bosch et al. 2006).

Different hypotheses concerning the use of these tools have been put forward. Whereas researchers at La Draga state that they may have been hooks used to suspend other objects, M. A. Fugazzola (2023) has recently proposed that the concave part of these items was used to smooth the walls of canoe-shaped ceramic artefacts that have been found at La Marmotta. Based on the abrasion and striations documented on these tools' concave and convex (toothed) parts, we think they may have been used for working with plant matter, such as flax. However, more specific functional studies are required to establish their use.

### Possible combs

Two possible teeth from combs have also been found among the wooden remains. These are small objects (46 x 4 x 3 mm and 49 x 6 x 6 mm) with a pointed end. Although they may also belong to some other type of tool, if we bear in mind the magnificent, almost complete combs recovered at such sites as La Draga (Bosch et al. 2006), this hypothesis should not be discarded.

### Tensioners

The study of pottery remains at La Marmotta has documented some perforated objects that might be interpreted as tensioners or weaving artefacts used to thread cloth or twine. Two of these are rounded in shape; a third specimen is irregular. Whereas the round ones are between 60 and 90 mm in diameter and between 7 and 12 mm thick, the irregularly-shaped one measures 62 x 40 x 35 mm (Fig. 10). Similar types of ceramic objects have been found at the sites of La Draga (Neolithic) and El Cerro de la Virgen de Orce, Prov. Granada (Spain; Bell Beaker period) (Schüle 1980; De Diego 2023). On the other hand, finds of similar appearance but made from *Spondylus* were found at the Makriyalos, Crete (Greece), Neolithic site and have been interpreted as buckles/buttons (Pappa/VeropoulIdou 2011).

### Lithic and bone instruments

Lithic and bone tools also had a role in the processing of vegetal fibres (Guilbeau et al. 2023). This can be determined through the study of use-wear traces conserved on their surfaces. Functional analyses were performed on a sample of 770 lithic artefacts, of which 418 had been used. Of these, many were employed in working with plant matter: 115 to harvest cereals, 67 to cut, and 86 to scrape indeterminate non-woody plants. In the case of blades forming part of a sickle, they are unretouched or only slightly retouched at both ends. Many of these objects with cereal use-wear display retouched active edges because they were frequently re-sharpened to prolong the sickle's life. This large number of tools used for harvesting and working with indeterminate non-ligneous plants indicates the importance of plants in the craft activities performed by the community at La Marmotta.

Among the implements made of bone, an initial study of 39 tools has been carried out. It is difficult to identify evidence of use-wear in the bone assemblage because of the poor conservation of cortical surfaces. Nevertheless, five of the six robust awls exhibited clear evidence of their use. However, it was only possible in one case to determine that it had been employed in working with plant matter, probably fibres, using a predominantly transverse movement. The other tools had probably been used, but their state of conservation does not allow this to be definitively affirmed.

**Fig. 10a–b** Possible tensioners or parts of looms, perforated around their perimeters.

***Abb. 10a–b*** *Mögliche Spannelemente oder Webstuhlteile, die an den Rändern perforiert sind.*

## Conclusions

Undoubtedly, one of the most significant gaps in our knowledge of prehistoric communities is related to the raw materials used, the different working processes, and the diversity of the tools employed to produce textiles, cordage, and basketry. Unfortunately, because these were made with biotic materials, no direct evidence is preserved at most sites, and we can only conceive of them through, for example, functional analysis of lithic and bone tools. Nature only opens a window to the past in a few exceptional cases, such as the site of La Marmotta, where we can identify and interpret the diversity of the artefacts and the range of tools linked to textile manufacturing. The remains briefly described here reflect both the diversity of the perishable materials used and the technical complexity and knowledge demonstrated by the first Neolithic societies in the production of textiles.

## Acknowledgements

This research was made possible by the research collaboration established between the Museo delle Civiltà and the Spanish National Research Council (CSIC). Several projects funded by the Ministry of Science and Innovation of Spain have also participated: PID2020-112513RB-I00/AEI/10.13039/501100011033, HAR2016-75201-P, PIAR-201818008, PIAR-201918010. Permission to use the photographs of La Marmotta and the archaeological artefacts was kindly granted by the Museo delle Civiltà.

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# Use-wear analysis of six bone tools found in the woman's grave of Bad Dürrenberg

Annelou van Gijn

**Zusammenfassung**

Gebrauchsspurenanalyse an sechs Knochenwerkzeugen aus dem Frauengrab von Bad Dürrenberg

*Die mikroskopische Analyse von sechs Knochenwerkzeugen aus dem »Schamaninnen«-Grab von Bad Dürrenberg, Saalekreis, ergab, dass sie nicht nur dieselbe* Chaîne opératoire *aufwiesen, sondern auch Teil eines Werkzeugsatzes waren, der für die Herstellung von Körben oder Kleidungsstücken aus pflanzlichen Materialien, wie Bast, Gräsern oder Nesseln bestimmt war. Alle Werkzeuge wurden aus Cervidenmetapodien gefertigt, entweder vom Rothirsch oder vom Reh, und durch Längsspaltung dieser hergestellt. Die Werkzeuge zeigen Spuren einer abschließenden Glättung und Politur durch Schachtelhalm, einer sehr abrasiven Pflanze, die häufig hierfür verwendet wurde. Obwohl die Werkzeuge aus Bad Dürrenberg nicht in einwandfreiem Erhaltungszustand waren und einige daher nicht im Detail untersucht werden konnten, brachte die mikroskopische Analyse einige Aspekte ihrer Entstehungsgeschichte ans Licht, die sonst nicht hätten wahrgenommen werden können.*

**Schlagwörter** Knochenwerkzeuge, Gebrauchsspurenanalyse, Pflanzenverarbeitung, Grabbeigaben, Mesolithikum

**Summary**

*The microscopic analysis of six bone tools from the ›shaman's‹ burial at Bad Dürrenberg, Saalekreis District (Germany), showed they not only share the same* chaîne opératoire *but also form part of one particular toolkit aimed at the production of baskets or garments made of plant-based materials , like bast, grasses or nettles. All tools are made on cervid metapodia, either of red deer or of roe deer, and are produced by longitudinal splitting. They all display the same process of finishing the tools, using horsetail, a very abrasive plant commonly used for this purpose. Although from Bad Dürrenberg tools were not in pristine condition and some could therefore not be studied in detail, microscopic analysis revealed some aspects of their biographies which are otherwise not recognised.*

**Keywords** Bone tools, microwear analysis, plant-based crafts, grave goods, Mesolithic

## 1 Introduction

The 1934 find of a double burial of a woman and child in the spa gardens of Bad Dürrenberg, Saalekreis District (Germany), is one of the most interesting graves from the Mesolithic. It is dated between 7000–6800 cal BC (Orschiedt et al. 2023) and thus predates any contact of the local Mesolithic population with Neolithic farmers. The woman was buried in a sitting position, with the child placed between her legs. She was surrounded by a large number and variety of grave goods. Amongst these were six bone implements, which were made on metapodia of red deer and roe deer. The grave was interpreted as the last resting place of a shaman (Grünberg et al. 2016), but research is ongoing (Orschiedt et al. 2023). The use-wear analysis performed on the six bone tools was intended to reveal the function of these objects and to see whether their biographies could shed more light on the interpretation of the grave.

## 2 Methodology

The six bone implements were sent by special delivery to the Laboratory for Material Culture Studies at the Faculty of Archaeology, Leiden University, and were treated with extreme caution. For this reason, we did not clean the artefacts apart from the very occasional and careful swipe with a bit of alcohol on a cotton tip. This meant that no attempt was made to remove the encrustations that covered large parts of the artefacts and impeded the microscopic analysis. These may be the remnants of the plastered wattle construction surrounding the grave. Generally, however, there were parts of the surface that were sufficiently clean to allow the interpretation of the traces of wear. We wore starch-free gloves at all times when handling the objects.

All artefacts were first examined by means of a stereomicroscope (a Leica M80 Stereo instruction microscope fitted with a Leica MC120HD camera) to observe traces of manufacture and macroscopic features of wear like edge removals. Subsequently, use was made of a Leica DM2700 metallo-

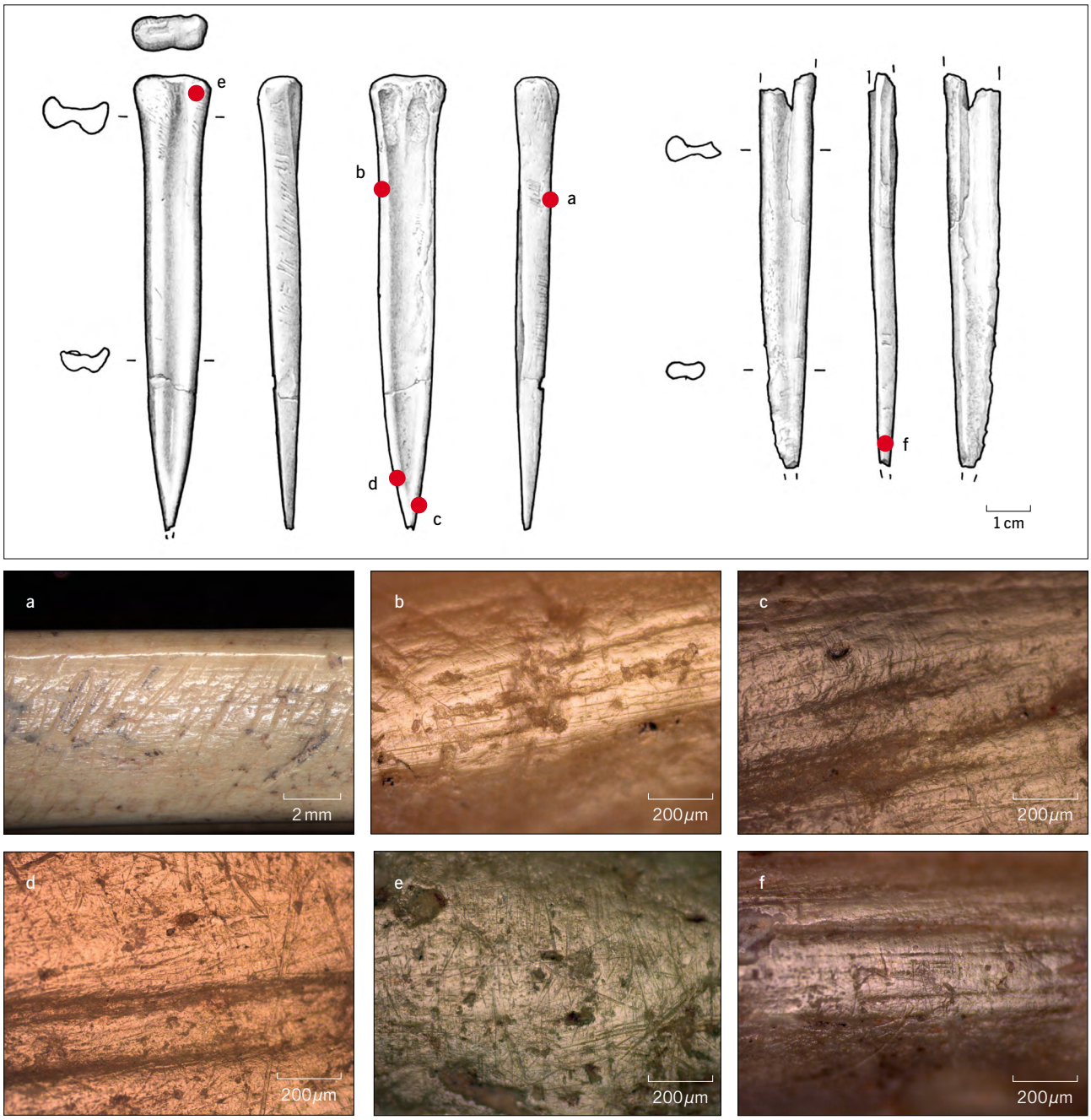
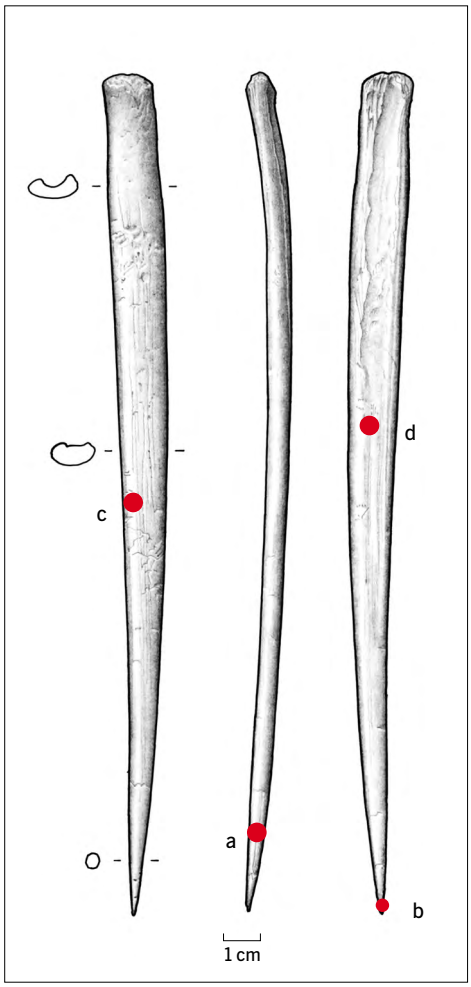



**Fig. 1a–f** a Incisions on tool HK No. 34:823i1, an awl, made by means of a stereomicroscope; b lacquer-like manufacturing gloss from polishing the tool surface with *Equisetum*; c–d use wear polish and striations interpreted to be associated with contact with silicious plant and/or bast; e handling traces on the butt end of the awl, characterised by numerous ›pinpricks‹; f lacquer-like manufacturing polish seen on tool HK No. 34:823i2. b–f were taken with a metallographic microscope with original magnifications of 100x.

***Abb. 1a–f*** *a Einschnitte am Werkzeug HK-Nr. 34:823i1, einer Ahle, die Aufnahme wurde mit einem Stereomikroskop angefertigt; b lackartiger Herstellungsglanz vom Polieren der Werkzeugoberfläche mit* Equisetum*; c–d Abnutzungspolitur und Riefen, die mit dem Kontakt mit kieselhaltigen Pflanzen und/oder Bast in Verbindung gebracht werden können; e Handhabungsspuren am Ende der Ahle, gekennzeichnet durch zahlreiche »Nadelstiche«; f lackartige Herstellungspolitur am Werkzeug HK-Nr. 34:823i2. b–f wurden mit einem metallografischen Mikroskop mit einer Originalvergrößerung von 100x aufgenommen.*

graphic microscope (magnifications of 50–300x), fitted with a Leica MC120HD camera to examine the polish, striations and rounding. Photos were taken using Leica's LAS 4.8 software.

It should be stressed that although we can determine the very presence of traces of use, like polish or striations, and describe their various features, it is not possible from a methodological perspective to determine the function of these objects with certainty. We can only interpret the activity that caused these traces to develop (see van Gijn 2014). The inferences are always made on the basis of a likeness between experimentally obtained traces of wear and the traces we observe on our archaeological objects. We can never exclude that such traces could also have been caused by an activity that we did not explore experimen-



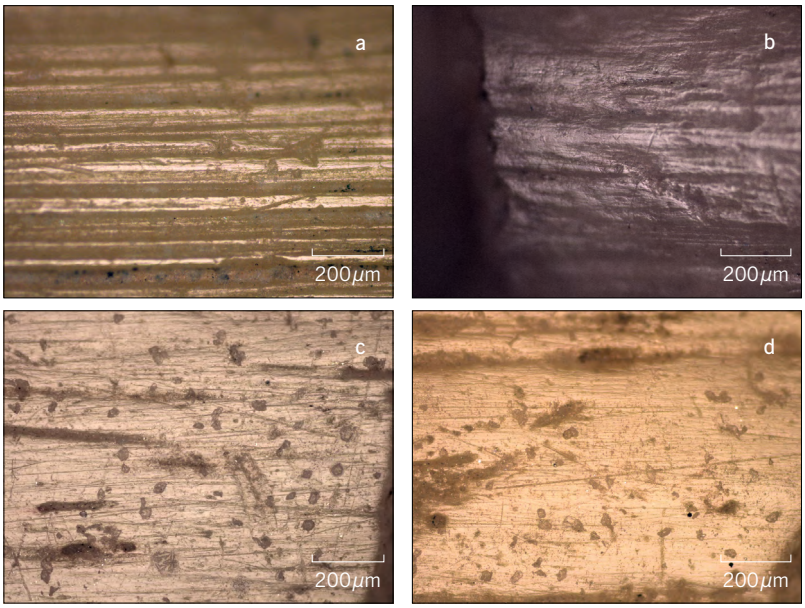




**Fig. 2a–d** Traces observed on tool HK No. 34:823i3. a Lacquer-like gloss associated with the manufacturing stage; b tip of the tool with a roughly textured polish that is interpreted as coming from contact with bast; c »Pinpricks« associated with handling traces; d handling traces and the manufacturing gloss. All photos were taken by metallographic microscope with original magnifications of 100x.

***Abb. 2a–d*** *Auf dem Werkzeug HK-Nr. 34:823i3 erkennbare Spuren. a Lackartiger Glanz, der mit der Herstellungsphase in Verbindung steht; b Spitze des Werkzeugs mit einer groben Politur, die vom Kontakt mit Bast stammen könnte; c »Nadelstiche«, die mit Gebrauchsspuren in Verbindung gebracht werden; d Bearbeitungsspuren und Herstellungsglanz. Alle Fotos wurden mit einem metallografischen Mikroskop mit einer 100-fachen Vergrößerung aufgenommen.*

tally. Moreover, the biography of many of these objects can be highly complex, with secondary use, repair, intentional destruction or other treatments resulting in the modification or even obliteration of previously present traces of use[1]. It is, therefore, very important to carefully examine the microstratigraphy of the various traces we observe on the tools in order to better understand their life histories.

## 3 Results

**Find 34:823i1** is an awl, made on a left metatarsus of red deer *(Cervus elaphus)*, split longitudinally, with a length of 10.3 cm and a width of 1.7 cm. It was made on the proximal end of the metatarsus. It displays some encrustations, possibly plaster from the grave construction mixed with ochre, but is generally in good condition. Unfortunately, the very tip of the object is missing, probably the result of a recent fracture. On one of the lateral edges, incisions are visible (Fig. 1a). The present author is not entirely sure whether these are indeed ornamental, as is suggested by J. Grünberg et al. (2016, 311), or whether they are linked to the intended function of the tool. The incisions are somewhat irregular, whereas we would expect ornamentation to be done with more care. Moreover, such incisions have also been observed on awls from the Late Neolithic site of Hekelingen III, South Holland Province, in the western Netherlands (pers. obs.), and experiments are currently underway to explore their potential significance in plant-based crafts. Along the length of this awl, a very shiny, lacquer-like polish can be seen (Fig. 1b). The fact that this highly lustrous gloss is visible along the entire length of the object suggests that it is linked to the manufacture and finishing of this awl, rather than its use. It is therefore suggested that the awl has been intentionally polished, most likely by horsetail *(Equisetum hyemale)*, a plant which has a kind of sand-paper-like surface that causes a very shiny and smooth polish. Towards the tip of the awl, this polish is overlain by a polish with a rougher, more matt, and striated texture that is considered to result from the use of the tool. It resembles polish that was experimentally obtained by making coiled baskets with a core of grass (Fig. 1c–d). In other spots, the polish appears more like the polish that we experimentally obtain from working bast. The tip, in particular, also displays striations that point not only to a longitudinal but also rotating motion,

1 Current experiments re-using awls on different materials and storing them in different ways has made us even more aware of the difficulty of assigning one specific funtion to these objects.

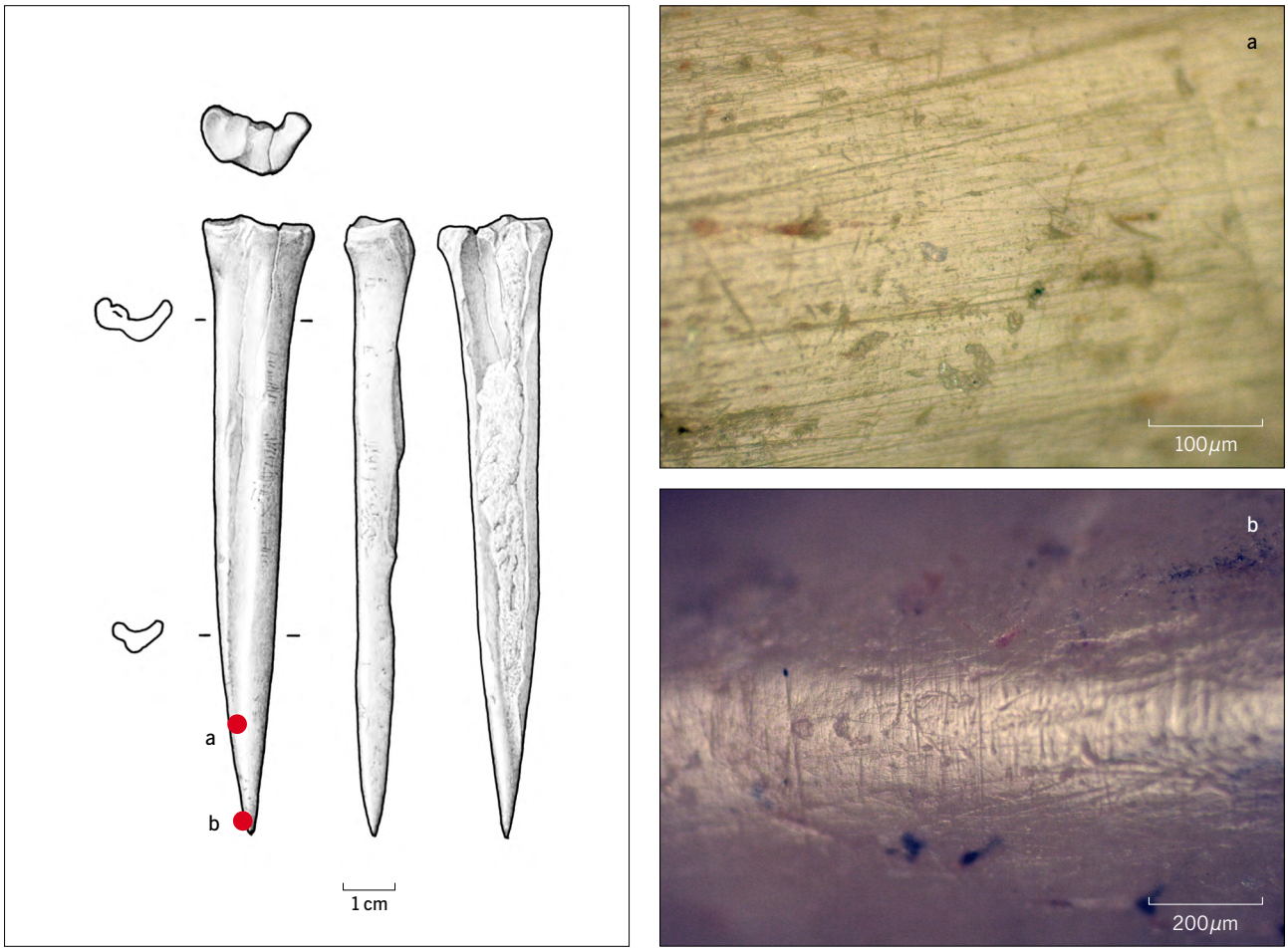



**Fig. 3a–b** Traces observed on tool HK No. 34:823i4. a Manufacturing gloss which is partially overlain by the actual use-wear traces which are due to contact with plant material. b The heavily rounded tip of the awl displaying a somewhat rough texture polish associated with bast and possibly plant. The circular striations indicate that the tool was certainly heavily used as an awl. Both photos taken by metallographic microscope, with original magnifications of 200x (a) and 100x (b).

***Abb. 3a–b*** *Auf dem Werkzeug HK-Nr. 34:823i4 erkennbare Spuren. a Fertigungsglanz, der teilweise von den eigentlichen Gebrauchsspuren überlagert wird und auf den Kontakt mit pflanzlichen Materialien zurückzuführen ist. b Die stark abgerundete Spitze der Ahle weist eine etwas raue Textur auf, die mit Bast und möglicherweise Pflanzen in Verbindung zu bringen ist. Die kreisförmigen Riefen deuten darauf hin, dass das Werkzeug sicherlich intensiv als Ahle benutzt wurde. Beide Fotos wurden mit einem metallografischen Mikroskop aufgenommen, mit Originalvergrößerungen von 200x (a) und 100x (b).*

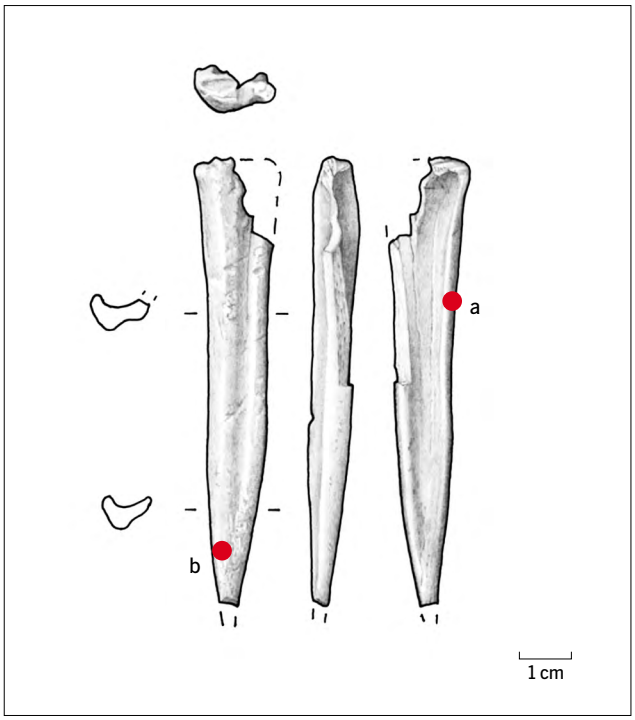
indicating that this tool was indeed used as an awl, most probably in the processing of plant materials and/or in the production of basketry. The last features that could be observed were possible prehension traces where the original intentional polishing of the object was damaged, perhaps by the rubbing of grass between the fingers of the user and the tool and the acidity of the fingers (Fig. 1e). The tool seems to have been quite intensively used. **Find 34:823i2** is an awl made on a metapodium of a roe deer *(Capreolus capreolus)*, with a length of 8.8 cm and a width of 1.2 cm. The tip is missing, as is the base of the tool. It is, therefore, not certain whether the tool was made on the distal or proximal part of a longitudinally split metapodium. This object is very poorly preserved, with encrustations covering almost all of the surface. It seems, however, that this tool, too, was intentionally polished with *Equisetum*, as here and there remnants of the very shiny lacquer-like gloss preserved (Fig. 1f). There are some very vague indications of use-wear traces, possibly from contact with plants, but these are insufficiently clear to provide a basis for a more solid inference.

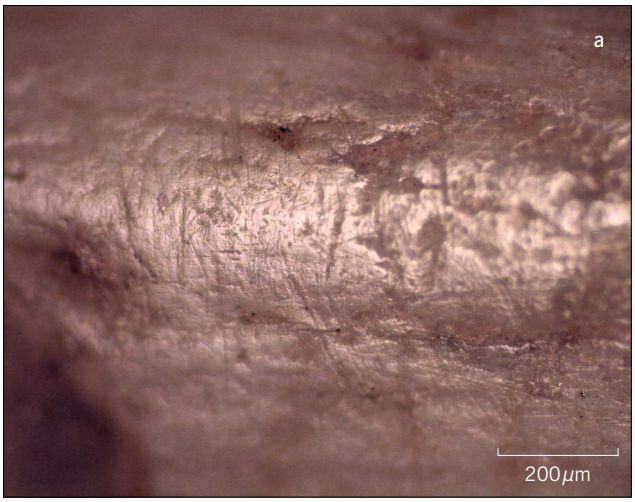
**Find 34:823i3** is classified as an awl, made on a longitudinally split right metacarpus of red deer *(Cervus elaphus)*. It measures 22.1 cm in length and 1.4 cm in width. Again, the tip is unfortunately missing, probably a recent fracture. Along most of its length it displays polish resembling the one we experimentally obtain by contact with *Equisetum*. The tool was thus intentionally polished, most likely with the aid of horsetail *(Equisetum hyemale)* (Fig. 2a). Towards the tip the tool has a somewhat roughly textured polish that resembles the one produced by bast (Fig. 2b). Interestingly, evidence for a rotation motion is absent on this tool, with only longitudinally oriented scratches associated with plant working traces. This indicates that the tool was used in a pushing motion, like a needle, and did not twist in the contact material as an awl does. A final feature is the presence of prehension traces: little pinpricks (Fig. 2c–d; Maigrot 1997).

**Find 34:823i4** is described as an awl. It is made on the proximal end of the longitudinally split right metatarsus of *Capreolus capreolus* and has a length of 11.9 cm and a width of 2.1 cm. This tool is very well preserved overall, with fewer encrustations present (it does display some patches of plasticine from previous documentation, which I did not attempt to remove). All along the length of the tool, a very shiny lacquer-like polish has been preserved, with thin longitudinally oriented striations. As with the previous tools, I interpret these traces as manufacturing traces, associated with traces of polishing the tool with – most likely – horsetail *(Equisetum hyemale*; Fig. 3a). This shiny polish is destroyed to a large extent at the tip by the traces associated with the actual use of this awl: heavy rounding of the tip and a somewhat rougher but still bright polish that is associated with plant working. Here, striations also indicate a rotating motion, congruent with the use as an awl (Fig. 3b). Whether this concerns a silicious plant or bast is difficult to tell; most likely the awl was in contact with both materials, as suggested by the combination of a slightly rougher texture due to contact with bast, and a brighter somewhat smoother polish commonly seen from working (silicious) plants. Towards its base, the tool also displays an area of pinpricks, which are believed to be related to handling by bare hands.

**Find 34:823i5**, again an awl, is made on the longitudinally split left metatarsus of a roe deer *(Capreolus capreolus)*. It measures 8.5 cm in length by 1.4 cm in width. This tool is not very well preserved, and its tip and base are missing. It displays patches of the lacquer-like polish that is interpreted as being the result of intentional polishing with horsetail (Fig. 4a). Subsequent use and also post-depositional surface modifications have removed most of this manufacturing polish. The tip displays a bright, roughly textured polish interpreted as being the result of contact with plants, probably bast. The striations indicate a rotational motion in accordance with its classification as an awl. The use-wear polish extends quite far along the length of the tool, indicating that it penetrated the contact material quite deeply (c. 4 to 5 cm; Fig. 4b).

**Find 34:823i6** is classified as a spatula. It is made on a longitudinally split metatarsus of *Cervus elaphus* and measures 16.4 cm in length and 1.8 cm in width. It is poorly preserved, and the large numbers written on its surface, as well as the presence of glue, render it basically unsuited for use-wear analysis. However, along the length of the tool, small patches of the lacquer-like polish were detected, indicating that this tool was finished in the same way as the other five, most likely by polishing with horsetail (Fig. 5a). The bevelled edge of the chisel end shows some ochre and is also quite rounded. There is also a small spot of flat, bright pol-



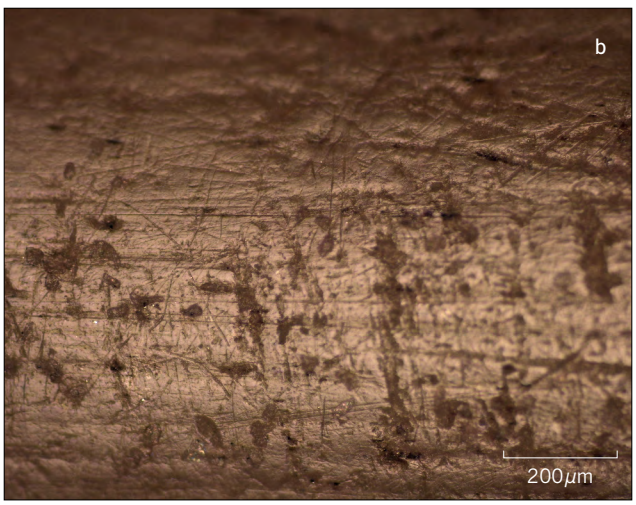




**Fig. 4a–b** Traces observed on tool HK No. 34:823i5. a The smooth manufacturing polish from *Equisetum* seen along the length of the tool; b Use wear polish and striations indicating a circular motion and contact with plant material like bast. Both photos taken by metallographic microscope with original magnifications of 100x.

***Abb. 4a–b*** *Auf dem Werkzeug HK-Nr. 34:823i5 erkennbare Spuren. a Glatte Herstellungspolitur, stammend von* Equisetum, *über die gesamte Länge des Werkzeugs; b Abnutzungspolitur und Riefen, die auf eine kreisförmige Bewegung und Kontakt mit Pflanzenmaterial, wie zum Beispiel Bast, hinweisen. Beide Fotos wurden mit einem metallografischen Mikroskop bei 100-facher Vergrößerung aufgenommen.*

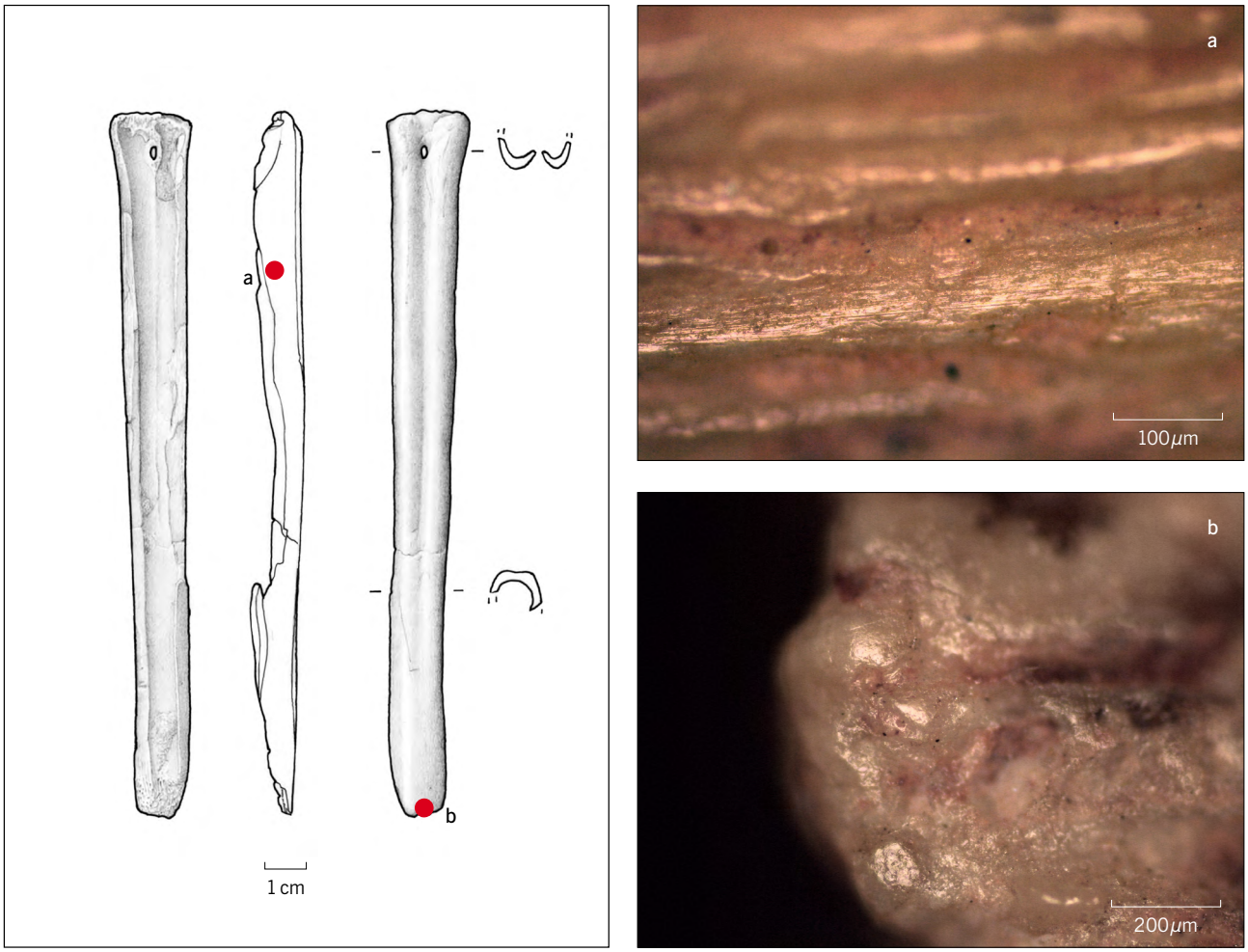



**Fig. 5a–b** Traces observed on tool HK No. 34:823i6. a Lacquer-like gloss associated with the manufacturing stage. b A somewhat smooth and bright polish interpreted as being associated with contact with mineral material. Both photos taken by metallographic microscope with original magnifications of 100x

***Abb. 5a–b*** *Auf dem Werkzeug HK- Nr. 34:823i6 erkennbare Spuren. a Lackartiger Glanz, der mit der Herstellungsphase in Verbindung gebracht wird. b Eine leicht glatte und helle Politur, die für einen Kontakt mit mineralischem Material spricht. Beide Fotos wurden mit einem metallografischen Mikroskop mit 100-facher Vergrößerung aufgenommen.*

ish presents that may be associated with contact with a mineral material, in this case probably ochre, but this is a very tentative inference (Fig. 5b).

## 4 Conclusion

The six tools examined for traces of manufacture and use were all produced in a similar manner: they were made on split metapodia of either roe deer or red deer. Especially red deer seem to have a special significance in Mesolithic cosmology (see a.o. Conneller 2011). Choosing metapodia as the raw material is logical as these bones carry the weight of hoofed animals and are ›designed‹ to sustain a large amount of pressure. This is, in principle, a very common technological choice when producing implements that must sustain longitudinally oriented pressure or impact, like awls or chisels. Given this, the use of metapodia in tool manufacture and use has been observed at countless Mesolithic and Neolithic sites (e.g. van Gijn 2005; van Gijn 2007), with the sole, possibly culturally determined technological choice being whether to retain the distal or the proximal end of the bone. In the case of the two awls from Bad Dürrenberg where this was possible to determine, the choice was to retain the proximal end for the base of the tool. The specimens studied also share similar finishing stages: they were all highly polished along their entire length. Most likely this was done by rubbing horsetail *(Equisetum hyemale)* along the length, which resulted in a lacquer-like polish that is highly reflective, very regular and quite smooth, but with a multitude of thin, narrow striations that run along the length of the tools.

In terms of use, the objects can be regarded as a toolkit for plant working activities, most likely involved in basketry. The microscopic analysis of the items reveals the practice of otherwise hidden technologies, the products of which have not been preserved (Hurcombe 2014; van Gijn/Little 2016). The awls display longitudinal scratches as well as perpendicular ones in the tip regions, indicating that they were pushed into the contact material and twisted. The polish is somewhat rough and matt in texture, although in some places, it resembles silicious plant polish because of

its brightness and smoothness. Most likely, the tools were in touch with both bast fibres (causing the rougher textured polish) and silicious plants (causing the brighter polish). A possible interpretation is that they were involved in making coiled basketry, but this variation in polish could also be due to their use in diverse plant-based crafts, involving different plant-based raw materials. The large needle-like awl had been used to push material and was used only in a longitudinal motion, in contrast to the awls. It is likely part of the same basketry-making toolkit as the awls. Interpreting the chisel is a bit more complicated as this tool was very poorly preserved and could not be fully studied. However, it may have been used to apply ochre to the baskets.

To conclude, the Bad Dürrenberg bone tools seem to have been part of a single toolkit, manufactured in the same way and used for the same activity. As such, they share similar biographies. Use-wear analysis of other categories of material culture, like flint or stone, may show whether such tools were also part of this toolkit. If the interpretation of this set of tools as being related to plant working – more specifically, basket making – is correct, the question remains how this fits in with the interpretation of the woman as a shaman. Plant-based crafts like basketry and weaving are notoriously time- consuming and often seen as women's activities. Because of the length of time required to make an item, be it a finely crafted basket or a woven garment, these activities are sometimes seen as representing the flow of life (Barber 1994). From that perspective, adding a plant-working toolkit to the burial gifts of a ›shaman‹ may be quite appropriate.

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1–5 drawings L. Kaudelka, LDA; photos author

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# The Palaeolithic origin of eyed needles

María Borao Álvarez, Natacha Caurette, François-Xavier Chauvière, Romain Malgarini, and Jean-Marc Pétillon

**Zusammenfassung**

Der paläolithische Ursprung der Öhrnadeln

*Verschiedene paläolithische Werkzeuge aus knöchernen Materialien können der Verarbeitung von Haut und Pflanzenfasern für die Herstellung von Kleidung zugeschrieben werden, wie z. B. Glätter, Ahlen und möglicherweise Doppelspitzen und* épingles. *Die Öhrnadel ist jedoch die technologische Innovation, die eindeutig den Beginn des aufwendigen Nähens im Paläolithikum markiert. Es handelt sich um ein Werkzeug, dessen Form und Verwendungsweise bis heute erhalten geblieben sind, auch wenn sich die Herstellungstechniken im Laufe der Zeit verändert haben. Dieses Werkzeug eignet sich perfekt für das manuelle Nähen, das von sich aus eine komplexe Angelegenheit ist, und hatte verschiedene technische, wirtschaftliche und kulturelle Auswirkungen auf die Jäger- und Sammlergesellschaften.*

*Wir legen hiermit einen kurzen und knappen Überblick über die veröffentlichte Forschung zum Ursprung der Öhrnadeln im Paläolithikum vor, die in verschiedenen Teilen der Welt zu unterschiedlichen Zeiten benutzt wurden, von Sibirien und dem Kaukasus bis nach China und Nordamerika, und über ihre Verbreitung in verschiedenen Gebieten mit ihrer Entwicklung und Formenvielfalt. Wir werden uns mit der Bedeutung morphometrischer Analysen befassen, die es uns ermöglichen, diese Entwicklung und Vielfalt innerhalb eines Technokomplexes und zwischen geografischen Gebieten und chronokulturellen Kontexten zu bewerten sowie verschiedene Hypothesen über ihren Ursprung und ihre Ausbreitung vorstellen.*

*Darüber hinaus erörtern wir technologische Fragen zu den verwendeten Rohstoffen (überwiegend Knochen, auch wenn einige Exemplare aus Geweih und Elfenbein gefunden wurden) und deren Umarbeitung zu Nadeln. Diesbezügliche Studien sind rar, und die meisten haben sich auf die Spätglazialzeit in Westeuropa konzentriert, gleichwohl sie sich allmählich auf andere geografische Gebiete und Epochen ausweiten. Daher untersuchen wir die unterschiedlichen Techniken, die bei der Herstellung ein und desselben Objekttyps zu verschiedenen Zeiten und an verschiedenen Orten der nördlichen Hemisphäre eingesetzt wurden.*

*Abschließend befassen wir uns mit der Frage nach der Verwendung der Nadeln, den Fäden, die möglicherweise verwendet wurden sowie Brüchen und Reparaturen dieser.*

**Schlagwörter** Knochenindustrie, Knochenwerkzeuge, Nahttechniken, Öhrnadeln, Jungpaläolithikum

**Summary**

*Various Palaeolithic tools made of osseous materials can be attributed to the processing of skin and plant fibres for clothing production, such as smoothers, awls, and possibly double points and* épingles. *However, the eyed needle is the technological innovation that unequivocally marks the beginning of intricate sewing in the Palaeolithic. It is a tool whose shape and mode of use have persisted until today, although its manufacturing techniques have changed over time. This tool is perfectly suited to manual sewing, which is inherently complex, and has various technical, economic, and cultural implications for hunter-gatherer societies.*

*We present a concise overview of the published research on the origin of eyed needles in the Palaeolithic, in different parts of the world and at different periods, from Siberia and the Caucasus to China and North America, and their spread across different territories with their evolution and diversity. We will address the importance of morphometric analyses that allow us to assess this evolution and diversity within a techno-complex and between geographic areas and chrono-cultural contexts, presenting different hypotheses proposed about their origin and dispersion.*

*Additionally, we discuss technological issues regarding the raw materials used (generally bone, although some specimens have been recovered in antler and ivory), and their transformation into needles. Studies in this regard are scarce, and most have focused on the Late Glacial period of Western Europe, although they are gradually extending to other geographic areas and periods. Thus, we examine the different techniques employed in producing the same object type at different times and places in the Northern Hemisphere.*

*Finally, we address the question of needle use, the threads that may have been used, fractures, and repairs.*

**Keywords** Osseous industry, bone tools, sewing technologies, eyed needles, Upper Palaeolithic

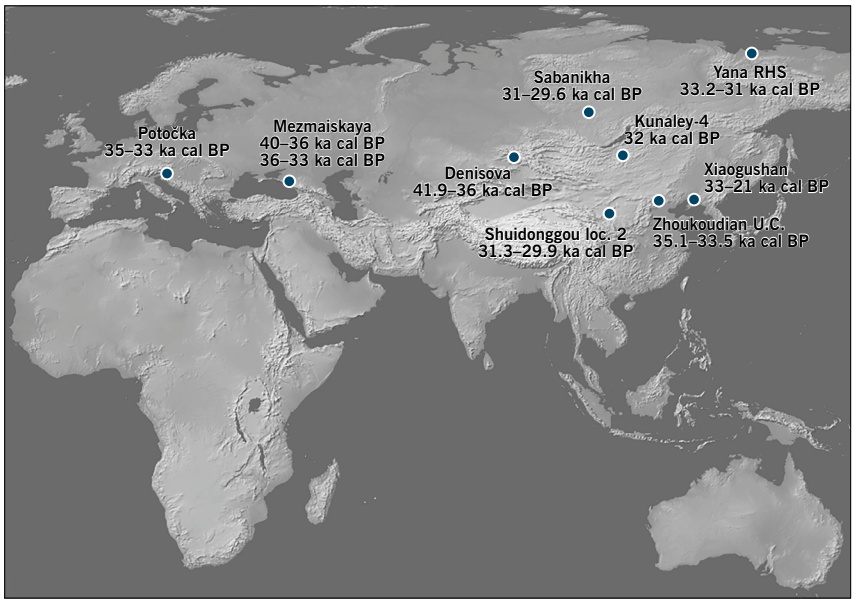



**Fig. 1** Location of sites cited in the text with eyed needles in the chronological range 40–30 ka cal BP.

***Abb. 1*** *Lage der im Text erwähnten Fundorte von Öhrnadeln im chronologischen Bereich 40–30 ka cal BP.*

## The Palaeolithic tools that may have been used for clothing manufacture

The earliest clothing discovered in prehistoric assemblages comes from Neolithic contexts with exceptional taphonomic conditions[1]. However, various indirect evidence of clothing manufacture and use was found in Palaeolithic archaeological sites in Africa, Eurasia, and America. For example, seven footprints found inside Cussac Cave, Dép. Dordogne, France, were linked to the use of footwear by hunter-gatherers during the Middle Gravettian (Ledoux et al. 2021).

Nevertheless, archaeologists rely on the technological (including functional) analysis of tools that may have been involved during hide or plant fibre processing, which may be linked to the production of clothing. Many lithic tools show use-wear traces associated with the scraping, cutting or piercing of animal hides throughout the Palaeolithic. As early as 800–900 ka BP, lithic tools from the TD6 level at Gran Dolina, Burgos Province, Spain (Carbonell et al. 1999) exhibit hide-working traces. This activity has become progressively more observed on Palaeolithic objects from Lower, Middle or Upper Palaeolithic contexts around the world with the increase in the number of traceological analyses[2].

Due to the frequent post-depositional alterations, use-wear analyses of osseous materials have been conducted less frequently and less systematically. The oldest occurrence of bone tools associated with hide or plant fibre processing are bone smoothers, made from flakes of bones, from the Lower Palaeolithic level of Schöningen, Helmstedt District, Germany (Julien et al. 2015). These objects show use patterns consistent with the rubbing of animal hides. Similar osseous tools have been found at Middle Palaeolithic sites, some of which display use-wear traces typically linked to hide processing[3]. Smoothers became more common during the Upper Palaeolithic. Made from flakes of bones, half ribs or antlers, they may have been used to transform hides or various plant materials[4].

Awls, alongside smoothers, are the most frequent Palaeolithic osseous tools associated with processing hide or plant fibres. The earliest awls were found in the Middle Palaeolithic context of Blombos Cave, Western Cape Province, South Africa, dated c. 73–70 ka (d'Errico/Henshilwood 2007). The objects are often found in Upper Palaeolithic contexts, but a high morphological variability characterises them. They have been produced from flakes or segments of bone or antler, complete pointed bones, and segments of ivory. During the Upper Palaeolithic, some double points or *épingles* were produced using similar manufacturing processes to those used for awls. Small osseous pointed objects have been associated with hide or textile piercing activities, possibly during clothing manufacture or sewing operations. Although some functional analyses have identified traces of use linked to hide-working (Bradfield 2015; Pitulko/Pavlova 2022; Caurette 2024), traceological studies on Palaeolithic awls are still rare, and their functions within the *chaînes opératoires* of hide-working require further investigation.

If smoothers and awls may have been used as active tools for working hides or plant fibres, an example of a bone anvil, which may have been involved during piercing hide operations, was found in the Aurignacian levels of Canyars, Barcelona Province in Spain (Doyon et al. 2023). A flat bone fragment of a large mammal exhibits several aligned puncture marks. They have been interpreted as the result of indirect percussion with a burin and a hammer, probably to pierce a soft material such as leather.

Finally, the last Palaeolithic osseous tool used to produce clothing is the needle. Exclusively associated with modern

1 Pütener/Moss 2010; Schlumbaum et al. 2010; Hafner 2012; Klügl et al. 2019; Rast-Eicher et al. 2021.

2 E.g. Keeley 1977; Rots et al. 2015; Lemorini et al. 2016; Gauvrit-Roux 2019; Venditti et al. 2019.

3 Mozota 2012; Soressi et al. 2013; Baumann et al. 2020; Hallett et al. 2021; Tartar et al. 2022.

4 E.g. Averbouh/Buisson 2003; Legrand 2004; Tartar 2009; Lacarrière et al. 2011.

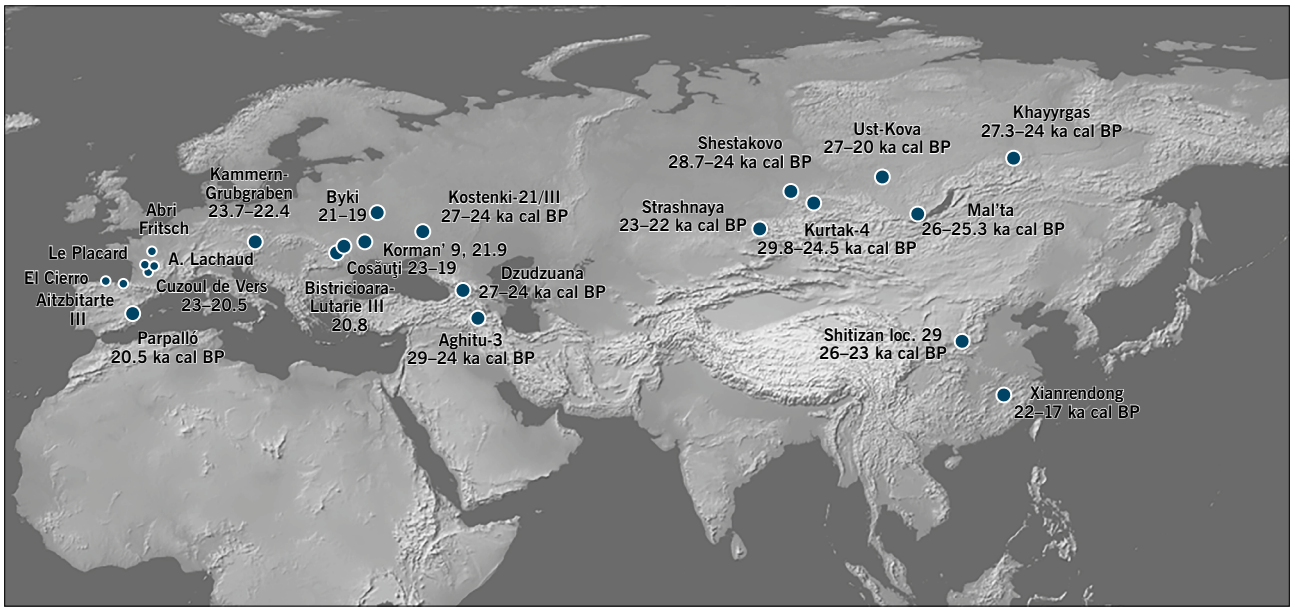



**Fig. 2** Location of sites cited in the text with eyed needles in the chronological range 30–20 ka cal BP.

***Abb. 2*** *Lage der im Text erwähnten Fundorte von Öhrnadeln im chronologischen Bereich 30–20 ka cal BP.*

human contexts, the needle is evidence for the production of complex clothing with elaborate stitches.

## The origin of eyed needles and their worldwide diffusion

The first eyed bone needles appeared in the Early Upper Palaeolithic. Where and when they first appeared, and their possible multiple origins, have been the subject of recent debate (Tab. 1; e.g. d'Errico et al. 2018; Fedorchenko/Belousova 2021; Gilligan et al. 2024). The earliest stratigraphies in which eyed bone needles have been identified are either not clearly defined, as is the case at Denisova, Altai Krai, Russia or are questionable due to bioturbations, such as at Strashnaya, Perm Krai, Russia. Denisova Cave has been ranked as the oldest site with eyed needles, with an age of 41.9–36 ka cal BP (Fig. 1) associated with the advent of the Anatomically Modern Human (AMH)[5]. Strashnaya Cave, on the other hand, has a needle in an undated context associated with a lithic industry characterised by the *Levallois* reduction concept[6]. The case of Mezmayskaya, Republic of Adygea, Russia, is very similar. Layer 1C (c. 40–36 ka cal BP) has produced one eyed needles, but the highest numbers of needles appear in the succeeding younger layers 1B and 1A, dating to c. 36 and 33 ka cal BP, respectively (Golovanova et al. 2010; Golovanova 2017). The chronological range of est. 35–30 ka cal BP is when the eyed needles appear in Siberia, China and the Caucasus, in some cases as isolated finds, in others in larger numbers. The Yana RHS site, Far Eastern District in north-eastern Siberia, has produced an exceptional collection of 192 eyed needles and fragments dating to 33.2–31 ka cal BP (Ferdochenko/Belousova 2021; Pitulko et al. 2012). Eyed needles appear at other Siberian sites such as Sabanikha, Krasnoyarsk Krai, Russia (31–29.6 ka cal BP) and Kunaley-4, Zabaykalsky Krai, Russia (32 ka cal BP; Fedorchenko/Belousova 2021). In China, several specimens have been uncovered at the Zhoukoudian Upper Cave, Beijing, China (< 35.1–33.5 ka cal BP; Li et al. 2018; Wang et al. 2020), at Xiaogushan, Liaoning Province, China (33–21 ka cal BP; Huang et al. 1986; Zhang et al. 1985, 2010; Wang et al. 2020) and at Shuidonggou loc. 2, Ningxia Hui Autonomous Region, China (31.3–29.9 ka BP)[7]. In the Caucasus, eight needles are recorded from layers 1B and 1A at Mezmayskaya, dating in roughly the same time interval, as mentioned above. The westernmost evidence of needles at this time is Potočka Cave, eastern Karawanks, Slovenia, where Odar (2008; Odar 2011) mentions the presence of an eyed needle, possibly dating to 35–33 ka cal BP, whereas Moreau et al. (2015) hint at stratigraphical problems. Furthermore, the interpretation of the object as an eyed needle is questionable (Odar 2006, Fig. 8; referenced by Odar 2008 as a needle).

In the time interval between 30 and 25 ka cal BP (Fig. 2), we observe a significant westwards dispersion of this morphotype and a proliferation of sites in the east. Good examples of eyed needles found in Eastern Europe come from the sites Kostenki 15, Khokholsky District, Russia (30 ka cal BP; Hoffecker 2005) and layer III at Kostenki 21 (27.5–24.5 ka cal BP; Goutas 2013; Reynolds et al. 2019). In the Caucasus, we also find isolated artefacts at Aghitu-3, Syunik Province, Armenia (29–24 ka cal BP; Kandel et al. 2017) and at Dzudzuana, Imereti Region, Georgia (27–24 ka cal BP; Bar-Yosef et al. 2011; Tejero et al. 2021). In central and eastern Siberia, needles are found in Kurtak-4, Krasnoyarsk Krai, Russia

5 Baumann et al. 2018; Derevianko et al. 2016; Fedorchenko/Belousova 2019; Shunkov et al. 2020.

6 Shalagina et al. 2018; Shunkov et al. 2020; Fedorchenko/Belousova 2021.

7 Guan et al. 2012; Li et al. 2013a; Li et al. 2013b; Wang et al. 2020.

| Site | Country | Chronology ka cal BP | Needles number | Technology mentioned | Bibliography |
|---|---|---|---|---|---|
| Denisova | Russia | 41.9–36.0 | > 8 | no | Baumann et al. 2018; Derevianko et al. 2016; Fedorchenko/Belousova 2019; Shunkov et al. 2020 |
| Mezmaiskaya | Russia | 40.0–36.0 | 1 | no | Golovanova et al. 2010; Golovanova 2017 |
| Yana RHS | Russia | 33.2–31.0 | 192 | yes | Ferdonchenko/Belousova 2021; Pitulko et al. 2012 |
| Sabanikha | Russia | 31.0–29.6 | 7 | no | Fedorchenko/Belousova 2021 |
| Kunaley-4 | Russia | 32.0 | 1 | no | Fedorchenko/Belousova 2021 |
| Zhoukoudian Upper Cave | China | 35.1–33.5 | 1 | no | Li et al. 2018; Wang et al. 2020 |
| Xiaogushan | China | 33.0–21.0 | 3 | yes | Huang et al. 1986; Zhang et al. 1985; Zhang et al. 2010; Wang et al. 2020 |
| Shuidonggou loc. 2 | China | 31.3–29.9 | 1 | yes | Guan et al. 2012; Li et al. 2013; Li et al. 2013a; Wang et al. 2020 |
| Mezmayskaya | Russia | 36.0–33.0 | 8 | no | Golovanova et al. 2010; Golovanova 2017 |
| Potočka | Slovenia | 35.0–33.0 | 1 | no | Odar 2006; Odar 2008; Odar 2011 |
| Kostenki 15 | Russia | 30.0 | + | no | Hoffecker 2005 |
| Kostenki 21/III | Russia | 27.5–24.5 | 1 | yes | Goutas 2013 |
| Aghitu-3 | Armenia | 29.0–24.0 | 1 | no | Kandel et al. 2017 |
| Dzudzuana | Georgia | 27.0–24.0 | 1 | no | Bar-Yosef et al. 2011 |
| Kurtak-4 | Russia | 29.8–24.5 | 1 | no | Fedorchenko/Belousova 2021; Shunkov et al. 2020 |
| Shestakovo | Russia | 28.7–24.0 | 11 | no | Fedorchenko/Belousova 2021 |
| Ust-Kova | Russia | 27.0–20.0 | 1 | no | Fedorchenko/Belousova 2021 |
| Khayrgas | Russia | 27.3–24.0 | 9 | no | Fedorchenko/Belousova 2021; Kuzmin et al. 2017 |
| Mal'ta | Russia | 26.0–25.3 | 70 | no | Fedorchenko/Belousova 2021; Shunkov et al. 2020 |
| Shizitan loc. 29 | China | 26.0–23.0 | 1 | no | Song et al. 2016 |
| Strashnaya | Russia | 23.0–22.0 | 1 | no | Krivoshapkin et al. 2018; Shalagina et al. 2018; Shunkov et al. 2020; Fedorchenko/Belousova 2021 |
| Xiarendong | China | 22.0–17.0 | 9 | no | Wu et al. 2012; Wang et al. 2020 |
| Cosăuţi | Moldavia | 23.0–19.0 | 51 | yes | Pfeifer 2024 |
| Byki | Czech Republic | 21.0–19.0 | 17 | yes | Demidenko 2020; Akhmetgaleeva/Burova 2021 |
| Korman'9 | Ukraine | 21.9 | 1 | no | Kulakovska et al. 2021 |
| Bistricioara-Lutaire III | Romania | 20.8 | 1 | no | Anghelinu et al. 2017 |
| Kammern-Grubgraben | Austria | 23.7–22.4 | 18 | yes | Pfeifer et al. 2024 |
| Cuzoul de Vers | France | 23.5–20.5 | 184 | yes | Le Guillou 2012; Borao/Pétillon unpubl. |
| Abri Fritsch | France | 23.5–20.5 | 71 | yes | Malgarini 2022; Borao/Pétillon 2024 |
| Abri Lachaud | France | 23.5–20.5 | 27 | yes | present study, J.-M. Pétillon and M. Borao |
| Le Placard | France | 23.5–20.5 | 82 | no | Breuil and Mortillet (S.D.), cited by Stordeur-Yedid 1979 |
| El Cierro | Spain | 17.0 uncal | + | no | Álvarez Fernández et al. 2016 |
| Parpalló | Spain | c. 20.5 | 4 | yes | Borao 2019; Borao 2022 |
| Aitzbitarte III | Spain | 28.0–22.0 | + | no | Calvo/Arrizabalaga 2020 |
| Afontova Gora II | Russia | 16.0–12.0 | > 7 | no | Derevianko et al. 2017 |
| Khayrgas | Russia | 19.8–16.9 | 55 | no | Fedorchenko/Belousova 2021; Kuzmin et al. 2017 |
| Strashnaya | Russia | 19.0 | 1 | no | Shalagina et al. 2018 |
| Shuidonggou loc. 12 | China | 12.2–11.1 | 11 | yes | Zhang et al. 2016; d'Errico et al. 2018 |
| Liyuzui | China | 21.0–12.0 | 1 | no | Doyon 2019 |
| Bailaiandong | China | 13.0 | 1 | no | Doyon 2019 |
| Shizitan loc. 9 | China | 12.8–11.7 | 2 | no | Doyon 2019 |
| Zengpiyan | China | 12.0–10.0 | 2 | no | Doyon 2019 |

| Site | Country | Chronology ka cal BP | Needles number | Technology mentioned | Bibliography |
|---|---|---|---|---|---|
| Nanzhuangton | China | 11.5–11.0 | 2 | no | Doyon 2019 |
| Gvardjilas Klde | Georgia | 17.0–15.5 | + | no | Golovanova et al. 2010; Golovanova et al. 2014; Golovanova 2017 |
| Chygai | Russia | 17.0–15.5 | + | no | |
| Dvoynaya | Russia | 17.0–15.5 | + | no | |
| Zatsurblia | Georgia | 17.0–15.5 | + | no | |
| Mezmaiskaya | Russia | 17.0–15.5 | 1 | no | |
| Skajia | Georgia | 17.0–15.5 | 1 | no | |
| Apiancha | Georgia | 19.0–13.5 | 2 | no | |
| Pekárna | Czech Republic | 12.0 | 121 | yes | Laznicková-Galetová 2010 |
| Křížová | | 12.0 | 1 | yes | |
| Žitného jeskyné | | 12.0 | 9 | yes | |
| Býcí skála | | 12.0 | 5 | yes | |
| Veruncina | | 12.0 | 2 | yes | |
| Kůlna | | 12.0 | 3 | yes | |
| Vogelherd | Germany | 16.2–15.0 | 14 | no | Schürch et al. 2024 |
| Gönnersdorf | Germany | ~ 15.8 | 63 | yes | Bignon-Lau/Galetova 2016 |
| Petersfels | Germany | 15.5–13.0 | ~ 2000 | yes | McCartin et al. 2023 |
| Monruz | Switzerland | 15.0–13.0 | 120 | yes | Bullinger et al. 2006 |
| Caldas | Spain | 20.2–12.6 | 105 | yes | Corchón/Garrido 2007, 2008 |
| Parco | Spain | 14.3 | 11 | yes | Tejero/Fullola 2006, 2008 |
| Bora Gran | Spain | Magdalenian | 20 | yes | Rueda/Torres 1987 |
| Parpalló | Spain | 14.0 | 13 | yes | Borao 2019; Borao 2022 |
| Cendres | Spain | 16.8–14.3 | 23 | yes | Borao 2012; Borao 2013; Villaverde et al. 2012 |
| Nerja | Spain | 14.2–13.1 | 7 | yes | Aura et al. 2020 |
| Church Hole | UK | 13.0–12.0 | 1 | no | Schawabedissen 1953, cited in Stordeur-Yedid 1979 |
| Kent's Cavern | UK | 13.0–12.0 | 1 | no | Evans 1878, cited in Stordeur-Yedid 1979 |
| Broken Mammoth | USA | 14.0, 11.8 | 1 | no | Osborn 2014; Hoffecker 2017 cited by Gilligan et al. 2024 |
| Hell Gap | | 13.1 | 1 | yes | Lyman 2015; Osborn 2014 |
| La Prele | | 12.9 | 4 | yes | Pelton et al. 2024 |
| Agate Basin | | 12.7 | 16 | yes | Lyman 2015; Osborn 2014 |
| Lindenmeire | | 12.7 | 25 | yes | Lyman 2015; Osborn 2014 |
| Buhl Burial | | 12.6 | 1 | yes | Lyman 2015; Osborn 2014 |
| Allen Sile | | 12.5–11.9 | 5 | yes | Lyman 2015; Osborn 2014 |
| Bonneville Estates | | 12.2 | 1 | yes | Lyman 2015; Osborn 2014 |
| Lind-Coulee | | 11.7 | 18–20 | yes | Lyman 2015; Osborn 2014 |
| Sentinel Gap | | 11.7 | 1 | yes | Lyman 2015 |
| Marmes | | 11.5 | 10 | yes | Lyman 2015; Osborn 2014 |
| Tula Lake Rockshelter | | 11.4 | 4 | yes | Erlandson et al. 2014 |
| Horn Shelter | | 11.1 | > 1 | yes | Lyman 2015; Osborn 2014 |
| Winkler | | 11.0 | 1 | yes | Lyman 2015; Osborn 2014 |
| O. V. Clay | | 10.1 | 2 | yes | Lyman 2015 |

**Tab. 1** Sites with eyed needles referenced in the text.

***Tab. 1*** *Im Text erwähnte Fundorte von Öhrnadeln.*

(29.8–24.5 ka cal BP; Fedorchenko/Belousova 2021; Shunkov et al. 2020), Shestakovo, Irkutsk Oblast, Russia (28.7–24 ka cal BP), Ust-Kova, Krasnoyarsk Krai, Russia (27–20 ka cal BP), Khayrgas, Republic of Sakha (Yakutia), Russia, layer 7 (27.3–24 ka cal BP; Fedorchenko/Belousova 2021; Kuzmin et al. 2017) and at Mal'ta, Irkutsk Oblast, Russia, at 26–25.3 ka cal BP, which yields some 70 needles (Fedorchenko/Belousova 2021; Shunkov et al. 2020). In China, Shizitan locality 29, Shanxi Province, dated to 26–23 ka cal BP, has produced one fragment of an eyed needle and a grey sandstone slab that displays grooves from the grinding of long and thin artefacts, most likely used in the production of needles (Song et al. 2016).

During the succeeding millennia, between 25 and 20 ka cal BP (Fig. 2), eyed needles continue in Asia, with sites such as Strashnaya (23–22 ka cal BP)[8] and Xiarendong, Jiangxi Province, China (22–17 ka cal BP; Wu et al. 2012; Wang et al. 2020), but now also become widespread all over Europe. In eastern Europe, at sites such as Cosăuţi, Soroca District, Moldova, with 51 needles (c. 23–19 cal ka BP; Pfeifer 2024), Byki 7, Kursk Oblast, Russia (21–19 ka cal BP; Demidenko 2020; Akhmetgaleeva/Burova 2021), Korman'9, Chernivtsi Region, Ucrania (c. 21.9 ka cal BP; Kulakovska et al. 2021), and Bistricioara-Lutaire III, Bistriţa County, Romania (20.8 ka BP; Anghelinu et al. 2017). In Central and Western Europe, eyed needles appear in Lower Austria, in Kammern-Grubgraben (23.7–22.4 ka cal BP; Pfeifer et al. 2024), and in France during the Badegoulian (23.5–20.5 ka cal BP) in sites like Cuzoul de Vers, Dép. Lot, with 184 needles (Le Guillou 2012; Borao/Pétillon unpubl.), and Abri Fritsch, Dép. Indre (Malgarini 2022a; Borao/Pétillon 2024). In Spain, they are documented at Parpalló, Valencia Province (Borao 2019; Borao 2022); in addition, Aitzbitarte III, Basque Autonomous Community (28–22 ka cal BP) has been recently referred to as a site with Solutrean needles (Gilligan et al. 2024), but as Calvo/Arrizabalaga (2020) point out, Solutrean and Badegoulian layers are mixed, and its chronology fits with the Badegoulian.

Between 20 and 10 ka cal BP (Fig. 3), eyed needles are widespread across the northern hemisphere, with specimens being identified in areas where they were already present, such as Siberia at Afontova Gora II, Krasnoyarsk Krai (16–12 ka BP; Derevianko et al. 2017), Khayrgas (19.8–16.9 ka cal BP; Fedorchenko/Belousova 2021; Kuzmin et al. 2017), and Strashnaya (19 ka cal BP; Shalagina et al. 2018), or in China in Shuidonggou loc. 12 (12.2–11.1 ka cal BP–Zhang et al. 2016; d'Errico et al. 2018), and other sites like Shizitan loc. 9 (12.8–11.7 ka cal BP), Liyuzui, Guangxi Zhuang Autonomous Region (21–12 ka cal BP), Bailaiandong, Guangxi Zhuang Autonomous Region (c. 13 ka cal BP), Zengpiyan, Guangxi Zhuang Autonomous Region (12–10 ka cal BP) and Nanzhuangton (11.5–11 ka cal BP; Doyon 2019). They also continue to be present in the Caucasus at sites such as Gvardjilas Klde, Imereti Region, Georgia, Chugai, Dvoynaya, Zatsurbliya, all Kabardino-Balkarian Republic, Russia, Mezmaiskaya layer 1–3 (17–15.5 ka cal BP), Skajia Cave, Imereti Region, Georgia and Apiancha (19–13.5 ka cal BP; Golovanova et al. 2010; Golovanova et al. 2014; Golovanova 2017).

In Europe, Magdalenian contexts, dated between c. 21 and 14 ka cal BP, yielded large assemblages of eyed needles. In Eastern Europe, we find important collections in the Czech Republic at sites such as Pekárna, Brno-Country District (with 121 needles), Křížová, Žitného, both Moravian-Silesian Region, Bycí skála, Blansko District, Verunčina, Blansko District, and Kůlna, Brno-County District (c. 12 ka BP; Lázničková-Galetová 2010). In Germany, the largest assemblage comes from Petersfels, Konstanz District, with over 2000 needles and by-products (15.5–13 ka cal BP; McCartin et al. 2023); other sites are Vogelherd, Heidenheim District (16.2–15 ka cal BP; Schürch et al. 2024), and Gönnersdorf, Neuwied District (15.8 ka cal BP; Bignon-Lau/Lázničková-Galetová 2016). In Switzerland, eyed needles were found in Monruz, Neuchâtel Canton (Bullinger et al. 2006). The high number of sites in France with large assemblages of needles is reviewed below. In Spain, the only technological studies reported are those from Las Caldas, Principality of Asturias (Corchón/Garrido 2007; Corchón/Garrido 2008), Parco, Province of Lleida (Tejero/Fullola 2006; Tejero/Fullola 2008), Bora Gran, Province of Girona (Rueda i Torres 1987), Parpalló, València Province (Borao 2022) and Cendres, Alicante Province (Borao 2012; Borao 2013).

Following the Magdalenian, eyed needles attributed to the Azilian technocomplex (c. 14–10 ka cal BP) come from French sites like Mas d'Azil, Dép. Ariège, Pégourié, Dép. Lot, Troubat, Dép. Hautes-Pyrénées, Tourasse, Dép. Haute-Garonne, and Bois-Ragot layer 3, Dép. Vienne, but are uncertain and debated due to possible stratigraphic admixtures[9].

Between 13 and 11 ka cal BP, needles are present in the Creswellian of the United Kingdom at sites like Church Hole, Derbyshire County and Kent's Cavern, Devon County (Evans 1878; Schwabedissen 1954, both cited in Stordeur-Yedid 1979).

To finish this tour of the needles' dispersion, they appear in North America shortly after 13 ka cal BP (Osborn 2014), spreading throughout the continent at sites such as Hell Gap, Platte County, Wyoming, USA (13.1 ka cal BP), La Prele, Converse County, Wyoming, USA (12.9 ka cal BP; Pelton et al. 2024), Agate Basin, Niobrara County, Wyoming, USA and Lindenmeier, Larimer County, Colorado, USA (12.7 cal BP), Buhl Burial, Twin Falls County, Idaho, USA (12.6 ka cal BP), Allen Site, Frontier County, Nebraska, USA (12.5–11.9 ka cal BP), Bonneville Estates, Knox County, Tennessee, USA (12.2 ka cal BP), Broken Mammoth, Tanana River Valley, Alaska, USA (11.8 ka cal BP), Lind-Coulee and Sentinel Gap, both Grant County, Washington, USA (11.7 ka cal BP), Marmes, Franklin County, Washington, USA (11.5 ka cal BP), Tula Lake Rock Shelter, Siskiyou County, California, USA (11.4 ka cal BP), Horn Shelter, Bosque County, Texas, USA (11.1 ka cal BP), Winkler-1, Winkler County, Texas, USA (11.0 ka cal BP),

8 Krivoshapkin et al. 2018; Shalagina et al. 2018; Shunkov et al. 2020; Fedorchenko/Belousova 2021.

9 E.g. for a critical review of the stratigraphy from Pégourié, see Ducasse et al. 2019; for a discussion of the possible Magdalenian origin of the needle found in the Azilian level of Bois-Ragot, see Christensen/Cholet 2005, 253–256; and for general statements on the disappearance of needles in the Azilian see Stordeur-Yedid 1979, 93.

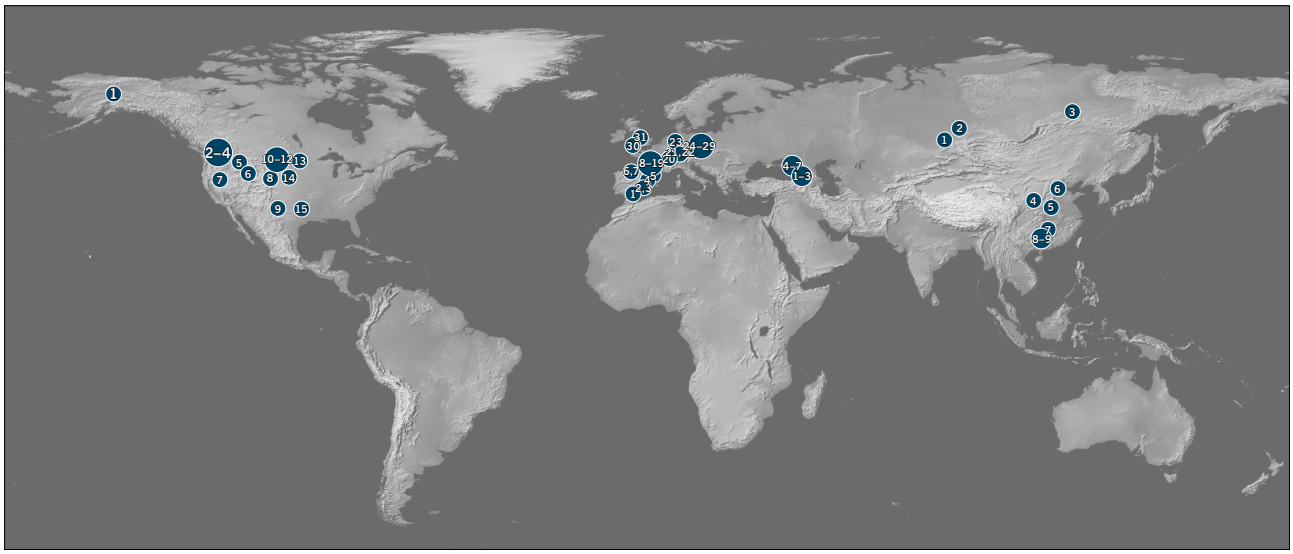


**Fig. 3** Location of sites cited in the text with eyed needles in the chronological range 20–10 ka cal BP.

***Abb. 3*** *Lage der im Text genannten Fundorte von Öhrnadeln im chronologischen Bereich 20–10 ka cal BP.*

**North America/*Nordamerika*:** 1 Broken Mammoth; 2 Lind-Coulee; 3 Sentinel Gap; 4 Marmes; 5 Buhl Burial; 6 Bonneville Estate; 7 Tula Lake Rockshelter; 8 Lindenmeier; 9 Winkler-1; 10 La Prele; 11 Agate Basin; 12 Hell Gap; 13 O. V. Clay; 14 Allen Sile; 15 Horn Shelter.

**Europe/*Europa*** 1 Nerja; 2 Cendres; 3 Parpalló; 4 Bora Gran; 5 El Parco; 6 Caldas; 7 Le Morin; 8 Isturitz; 9 Gazel; 10 Arlay/Grappin; 11 Solutré Route de la Roche; 12 La Madeleine; 13 Aurensan; 14 Saint-Michel, d'Arudy; 15 Bois-Ragot; 16 La Vache; 17 Peyrazet; 18 Grotte des Romains; 19 Les Hoteaux; 20 Monruz; 21 Petersfeld; 22 Vogelherd; 23 Gonnersdörf; 24 Kůlna; 25 Veruncina; 26 Býcí skála; 27 Žitného jeskyné; 28 Křížová; 29 Pekárna; 30 Kent's Cavern; 31 Church Hole.

**Caucasus/*Kaukasus*** 1 Skajia; 2 Zatsurblia; 3 Gvardjilas Klde; 4 Mezmaiskaya; 5 Dvoynaya; 6 Chigay; 7 Apiancha.

**Asia/*Asien*** 1 Strashnaya; 2 Afontova Gora II; 3 Khayrgas; 4 Shuidonggou loc. 12; 5 Shitizan loc. 9; 6 Nanzhuangton; 7 Zengpiyan; 8 Bailaiandong; 9 Liyuzui.

and O. V. Clay, Garden County, Nebraska, USA (10.1 ka cal BP; Erlandson et al. 2014; Lyman, 2015; Osborn 2014). Eyed needles in North Ameri ca are associated with the Younger Dryas chronozone (c. 12 900 to 11 600 cal BP) and are interpreted as a response to the return of a near-glacial climate (Pelton et al. 2024).

## The manufacture of eyed needles around the world

Eyed needles, being very small tools, are particularly subject to stratigraphic admixtures and are often found outside of their original contexts. However, the association of manufacturing remains or by-products with the needles themselves is one of the strong arguments in favour of their linkage to a specific technocomplex. Therefore, the presence of different technical categories (blanks, preforms and waste products) is of great interest; such finds reveal that (and how) needles were manufactured in a specific archaeological assemblage at a specific site, enabling us not only to recognise different craft traditions and thus collaborate in the compilation of »cultural maps« and exchange networks, but also to corroborate their »cultural phylogeny«. Until today, the manufacturing of eyed needles has received little attention worldwide. Due to the low number of specialists in the field and the relatively recent development of dedicated methodologies for technological analysis (e.g. Averbouh 2000; Averbouh 2001; Averbouh 2010), this type of analysis has started to develop only in recent years, especially in Europe. Among the few available references to the manufacturing process, many focus on shaping and finishing techniques like drilling, surface polishing, and the presence or absence of repairs and resharpening.

The oldest evidence of needle manufacture comes from the Denisova Cave. Several publications describe debitage created by obtaining elongated blanks through longitudinal splitting or cutting. The blanks are then shaped by scraping, abrasion, and polishing; then, in the proximal part, there is a scraping reduction in order to perform the drilling, usually from two faces of the item[10]. However, by-products have not been described or published, and M. Baumann refers to their absence in the assemblages (pers. comm.). The Strashnaya site documents the same parameters underlying the debitage, the shaping, and the drilling process (Shalagina et al. 2018; Krivoshapkin et al. 2018), but the by-products of these processes have not been published.

Two different drilling techniques have been described in China: bifacial drilling in Xiaogushan and drilling by

10 Baumann et al. 2018; Derevianko et al. 2016; Shunkov et al. 2020; Shunkov et al. 2021.

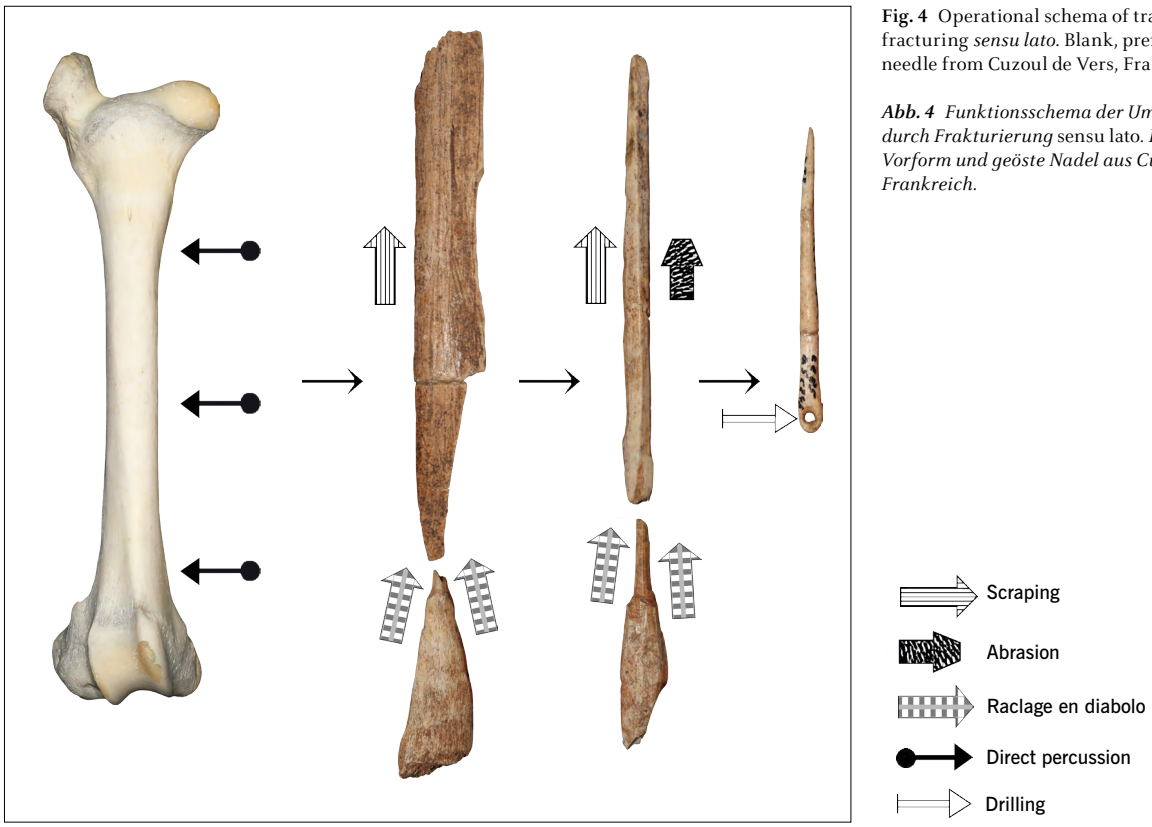



**Fig. 4** Operational schema of transformation by fracturing *sensu lato*. Blank, preform and eyed needle from Cuzoul de Vers, France.

***Abb. 4*** *Funktionsschema der Umwandlung durch Frakturierung* sensu lato. *Rohling, Vorform und geöste Nadel aus Cuzoul de Vers, Frankreich.*

pressure in Zhoukoudian Upper Cave (Zhang et al. 1985; Huang et al. 1986). In addition, the use of sawing, cutting and scraping techniques has been described in the context of harpoon manufacture (Zhang et al. 1985). The technological observations on the latter's production could, perhaps, be transferred to the manufacture of needles, although no material evidence has been recovered, neither in Xiaogushan nor Shuidonggou loc. 2 (Guan et al. 2012).

In Austria, at the Kammern-Grubgraben site (23.7–22.4 ka cal BP), 16 bone and two ivory eyed needles were identified, as well as various manufacturing by-products (Pfeifer et al. 2024). The operational schema of transformation identified is by fracturing *sensu lato* as the blanks to produce needles are selected bone flakes. The blank is shaped by scraping, and the extremities are detached by *raclage en diabolo* to calibrate the tool. The needles are drilled either before or after the calibration.

In Cosăuţi and Byki (Moldavia and Czech Republic; 23–19 ka cal BP), the operational schema of transformation by extraction is identified through the so-called Groove and Splinter Technique (GST) associated with the Early Epigravettian of the region (Pfeifer 2024; Akhmetgaleeva/Burova 2021).

At the end of the Chinese Upper Palaeolithic, it appears that two coetaneous operational schemas were identified in Shuidonggou loc. 12 (d'Errico et al. 2018). In both cases, blanks are produced by longitudinal splitting; the blank outline is then regularised by flaking or retouching and finally shaped by scraping, abrasion, and drilling just on one side or by taking advantage of the natural foramen of the long bone without modifying it. Finally, the preform is polished and the needle is finished. The main difference between both needle reduction sequences is the raw material used. Flat bones like ribs are used in manufacturing flat needles with oval sections (with some exceptions), while diaphyseal long bones are used for needles with sub-circular cross-sections. It can thus be said that raw material morphology predetermines the shape of the final product, which does not occur randomly but is possibly due to functional intentionality or utilising the available materials.

Finally, around 12.9 ka cal BP, debitage by extraction is identified in La Prele, a Paleoindian site in Wyoming. Metapodials of *Canidae*, *Felidae* and *Leporidae* are debited through GST. Two preforms have been identified, but shaping traces are lacking, so we would classify them as blanks (Pelton et al. 2024). This technological analysis is of interest because there are convergences, on the one hand, between North American technical traits with the Magdalenian and, on the other, the use of bones of leporids used in the osseous industry[11].

## Production of eyed needles in the Badegoulian

As noted above, Badegoulian needles have been recovered in France and Spain. In France, there are many sites with

11 E.g. Fontana/Chauvière 2007; Lázničková-Galetová 2010; Borao 2012; Borao 2022; Malgarini 2010; Malgarini 2022a; McCarthy et al. 2023.

Badegoulian eyed needles. Some of the largest assemblages are from Cuzoul de Vers, with 184 eyed needles and 71 by-products (Le Guillou 2012; present study, J.-M. Pétillon/M. Borao), and Abri Fritsch, with 71 eyed needles and 15 by-products (Borao/Pétillon 2024; Malgarini 2022a). In Spain, they have been identified at sites such as El Cierro, Principality of Asturias (Álvarez-Fernández et al. 2016) or Parpalló (Borao 2019; Borao 2022), but the number of specimens is low.

The objects and by-products studied from all these sites (except El Cierro, where the technology remains unstudied) show the same transformation operational schema by fracturing *sensu lato* (Fig. 4). This operational schema consists of selecting diaphyseal flakes derived from butchery activities based on their morphometric characteristics. These flakes are shaped by longitudinal scraping. Numerous waste products related to the shaping phase have been identified: they show fresh fracture planes on their sides, heavy scraping, and are sectioned from the blank using the *raclage en diabolo* plus bending techniques (Le Dosseur 2003). This technique is used to calibrate the object's length. Then, the preform is finished by abrasion and bi-conical drilling by alternate rotation. Finally, distal resharpening and repair of the perforations are observed in some pieces, as well as use-wear traces such as polishing and bending fractures, generally with »tongue« morphology.

Regarding morphometric characteristics, when focusing only on the Ancient Badegoulian of Cuzoul de Vers we observe a high degree of variability (Fig. 5). The eyed needles' lengths (of complete or almost specimens) measure between ~ 2 and 8.72 cm (mean ± 4,31 cm), widths from 1.7 to 5 mm, and thicknesses from 1.1 to 3.5 mm; their section-shapes are circular (~ 52 %) or oval (~ 45 %). Contrary to what has been argued until now (e.g. d'Errico et al. 2018), it is not during the Magdalenian that morphometric variability appears, but already during the Badegoulian.

**Fig. 5** Eyed needles from Cuzoul de Vers (France), Ancient Badegoulian.

***Abb. 5*** *Öhrnadeln aus Cuzoul de Vers (Frankreich), Früheres Badegoulien.*

| | | Les Scilles (Chauvière et al. in press) | Houleau (Chauvière et al. in press) | Taillis des Coteaux (Houmard 2023) | Saint-Germain-la-Rivière. Ensemble supérieur (Langlais et al. 2015) | Saint-Germain-la-Rivière. Ensemble inférieur (Langlais et al. 2015) | Gabillou (Langlais et al. 2023) | Roc-de-Marcamps (Langlais et al. 2015) | La Madeleine (Fontana/Chauvière 2007) | Les Petits Guinards (Fontana et al. 2003) | Grand Pastou (Chauvière 2006) | Dufaure (Chauvière 2006; Pétillon inédit) | Peyrazet (Pétillon 2021) | Solutré-Route de la Roche (Malgarini 2022a) | Arlay-Grappin (Malgarini 2014) | Farincourt (Malgarini 2014) | Arancou (Bonnissent/Chauvière 1999) | Saint-Michel d'Arudy (inédit) | Bois ragot (Christensen/Chollet 2005) | Les Romains (Malgarini 2014) | Schweizersbild (Höneisen 1994) | Neuchâtel-Monruz (Bullinger/Müller 2006) | Hauterive-Champréveyres (Leesch 1997) | Pincevent, IV-O (Malgarini 2010) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ursus* sp. | metatarsus | | | | | x | | | | | | | | | | | | | | | | x | | |
| *Canis lupus* | metacarpus | | | | | x | | | | | | | | | | | | | | | | | | |
| | radius | | | | | | | | | | | | | | | x | | | | | | | | |
| *Alopex lagopus* | tibia | | | | | | | | | | | | | | | | | | | | | x | | |
| *Vulpes* sp. | tibia | | | | | | | | | | | x | | | | | | x | x | | | | | |
| *Equus ferus* | hyoid bone | | | | | | | | | | | | | | | | | | | | | x | | |
| | ribs | | | | | | | | | | x | | | | | | | | | | | x | | |
| | radius | | | | | | | | | | | | | | | | | | | | | x | | |
| | metapodial | | | | | | | x | | | x | | | x | x | | | | | | x | | | |
| | metatarsus | | | | | x | | | | | | | | x | | | | | | | | | | |
| | metacarpus | | | | | | | | | | x | | | | | | | | | | | | | |
| *Rangifer tarandus* | scapula | | | | | | | | | | | x | | | | | | | | | | | | |
| | radius | | | | | | | | | | | | | | | | | | | | | x | | |
| | ulna | | | | | | | | | | | | | | | | | | | | | x | | |
| | metapodial | | | x | | | | x | | | | | | | | | | | | | | | x | x |
| | metatarsus | | | | | x | | | | | | | x | | | | x | | x | | | | | |
| | metacarpus | | | | x | | | | | | | | | | | | | | | | | | | |
| | tibia | | | | | | | | | | | | | | x | | | | | | | | | |
| | radius-ulna | | | | | | | | | | | | | | | | | | | | | | | |
| *Saiga tatarica* | ulna | | | | x | | | | | | | | | | | | | | | | | | | |
| | metapodial | | | | | | | x | | | | | | | | | | | | | | | | |
| | metacarpus | | x | | x | x | | | | | | | | | | | | | | | | | | |
| *Rangifer/Capra* | radius-ulna | | | | | | | | | | | | | | | | | | | | | x | | |
| *Capra ibex* | radius-ulna | | | | | | | | | | | | | | | | x | | | | | | | |
| | metatarsus | | | | | | | | | | | | | | | | x | | | | | | | |
| *Rupicapra rupicapra* | metapodial | | | | | | | x | | | | | | | | | | | | | | | | |
| | metacarpus | x | | | | | | | | x | | | | | | | | | | | | | | |
| *Lepus timidus* | radius | | | | | | | | x | | | | | | | | | | | | | | | |
| | femur | | | | | | | | x | | | | | | | | | | | | | | | |
| | tibia | | | | | | | | x | | | | | | | | | | | | | | | |
| | metatarsus | | | | | | | | x | | | | | | | | | | | | | | | |
| *Lepus* sp. | humerus | | | | | | | | | | | | | | | | | | | | | x | | |
| | tibia | | | | | | | | | | | | | x | | | | | | | x | x | x | x |
| *Aquila chrysaëtos* | tibiotarsus | | | | | | | | | | | | | | | | | | | x | | | | |
| | radius | | | | | | | | | | | | | | | | | | | x | | | | |
| *Nyctea scandiaca L.* | tibiotarsus | | | | | | x | | | | | | | | | | | | | | | | | |
| *Grus* sp. | ulna | | | | | | | | | | | | x | | | | | | | | | | | |
| *Cygnus cygnus* | humerus | | | | | | | | | | | | | | | | | | | x | | x | | |
| | tibiotarsus | | | | | | | | | | | | | | | | | | | | | x | | |
| *Cygnus olor* | humerus | | | | | | | | | | | | | | | | | | | x | | | | |
| *Anser* sp. | humerus | | | | | x | | | | | | | | | | | | | | | | x | | |
| *Gavia artica* | humerus | | | | | | | | | | | | | | | | | | | | | x | | |
| Aves indet. | humerus | | | | | | | | | | | | | | | | | | | | x | x | | |

**Tab. 2** Raw material used for the production of Magdalenian needles in France and Switzerland.

***Tab. 2*** *Rohmaterial für die Herstellung von Magdalénienadeln in Frankreich und der Schweiz.*

## Production of eyed needles in the Magdalenian

### Raw materials

The osseous material used to manufacture Magdalenian eyed needles is bone and, more rarely, antler (mainly for objects called «Bodkins», see below). In the case of specimens made of bone, the identification of the source of the blanks (animal species and skeletal elements) is essentially based on the analysis of the pieces of raw material (waste products). A few needles made from the bones of small species still show the marrow canal (Fig. 6,3.10) or the spongy tissue (cf. Fig. 6,8) on the lower side.

The animal species used are almost exclusively herbivores (mega- and mesofauna, from horse to *Leporidae*, reindeer, saiga, ibex, and so forth) and birds. Carnivores (fox, wolf, bear) received very little attention (Tab. 2). Animals and skeletal elements are acquired through hunting (bones of herbivores) and gathering (shed antler, and perhaps certain bird bones).

Apart from the reindeer antler, the hyoid bone is the only element of the cranial skeleton to have been exploited. Ultimately, it is the post-cranial skeleton which, for all the species identified, provides the blanks used for the manufacture of eyed needles. Among flat bones, while ribs were regularly used, the scapula was only exceptionally used. Most identified waste products come from long bones: humerus, ulna and radius, tibia, and above all, the metapodials of large and medium-sized ungulates. We note the rare use of the tibiotarsus of certain birds, such as the whooper swan.

### Manufacturing techniques

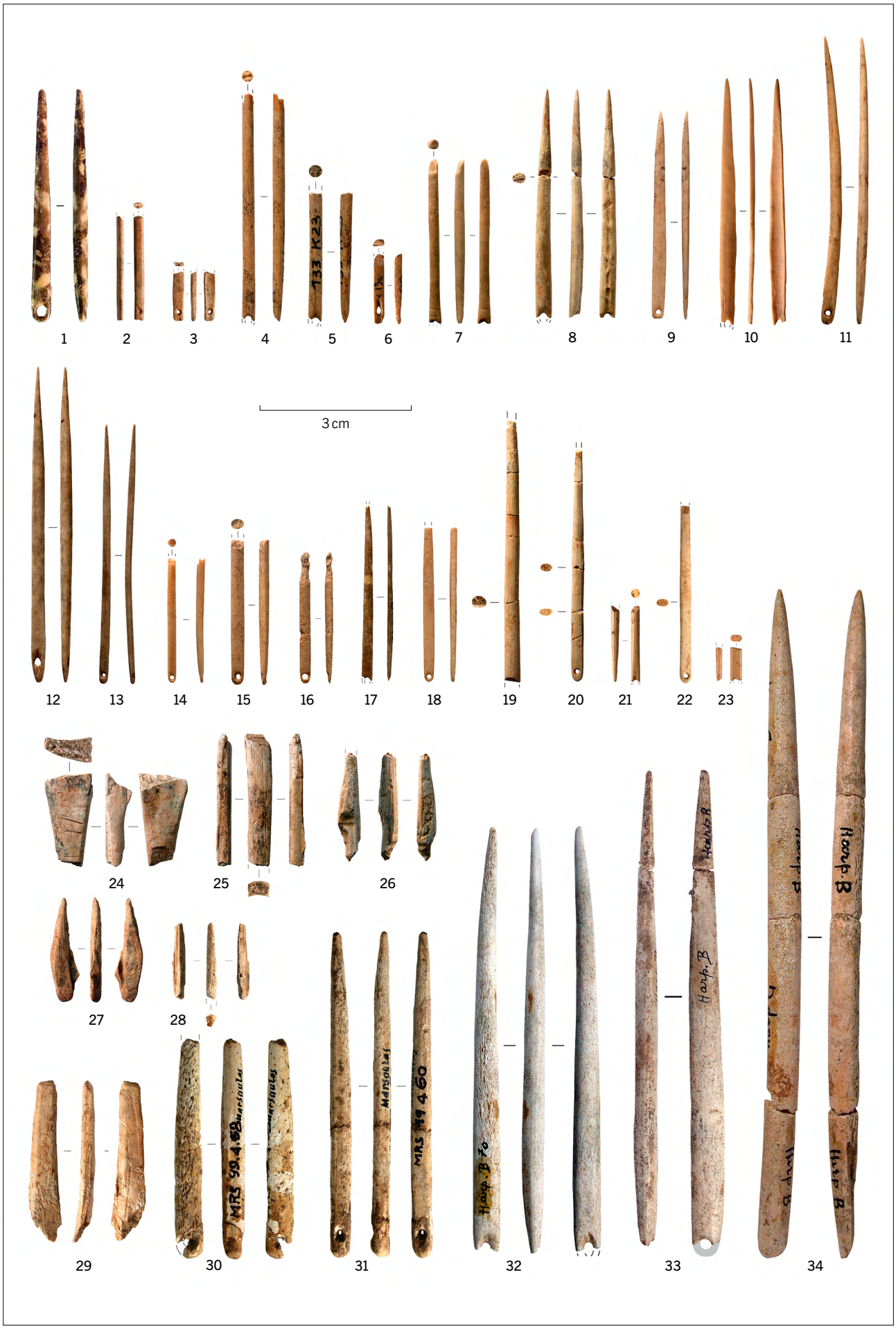
The selected bones undergo an initial surface preparation by scraping (to eliminate the rest of the soft tissue: flesh and periosteum).

In the Magdalenian, the blanks are obtained by GST (parallel or convergent grooving; cf. Fig. 6,24–29). In the majority of cases, the blanks are made directly from the block of raw material (antler or bone) or from a secondary block (sectioned bez tine or split bone). The width of the rods is small (around 5 mm), and they are quadrangular in section. Depending on the dimensions of the bones and the species used (Fig. 7), several blanks can be extracted from the blocks: traces of multiple grooving are identified on one side (metapodials of horses [cf. Fig. 7,8–9, reindeer, cf. Fig. 7,1–3) or on the entire periphery of the block (bird

| Assemblage | Phase | Number | Length | Width in mm | Thickness in mm | Reference |
|---|---|---|---|---|---|---|
| Gazel | MM | 95 [14] | 30–60 (Ø 47) | 2–4 | 1–3 | JMP unpubl. |
| Isturitz layer SI/Ew | MM | 51 [4] | 45–91 | 2–3 | 1–2 | Chavigneaud 2004, 72 |
| Isturitz layer II/E | MM | 43 [16] | 33–90 | 2.3–4.3 (Ø 2.9) | 1.3–3.2 (Ø 2.5) | Chavigneaud 2005, 19 |
| Arlay/Grappin | MM | 6 [2] | 43–55 | 1.9–3.0 | 1.6–2.3 | Malgarini 2014 |
| Solutré Route de la Roche | MM | 57 [0] | not given | 1.4–4.8 | 1.1–4.9 | Malgarini 2022a |
| La Madeleine | MUM | 23 [5] | generally 23–36 (max 66) | 1.6–5.1 | 1.1–4.3 | Treuillot 2012, 214 Fig. 3 |
| Aurensan | MUM | 10 [1] | 27 | Ø 2 | not given | Baumann 2007, 29 |
| St-Michel, Arudy | MUM | 10 [5] | 43–63 (Ø 52) | 1–3 (Ø 2.2) | 1.0–2.5 (Ø 1.6) | Pujol 2009, 20 |
| Bois-Ragot, layer 5 | UM | 99 [10] | 34–70 | 1.0–3.2 (Ø 2.2) | 1.2–4.4 (Ø 1.9) | Christensen/Chollet 2005, 234 |
| La Vache | UM | 423 [38] | generally 35–55 | generally 2.0–2.5 | generally 1.5–2.0 | Chauvière 2003a, 327 |
| El Parco | UM | 10 [1] | 51 | 1.5–3.0 | 1–2 | Tejero/Fullola 2008, 11 Tab. 2 |
| Le Morin | UM | 111 [2] | 39 and 49 | 2–4 | 1–3 | McComb 1989, 201 |
| Peyrazet | UM | 23 [1] | 56 | 1.7–3.5 (Ø 2.3) | 1.1–2.6 (Ø 1.8) | Pétillon 2021, 104 |
| Les Romains | UM | 58 [0] | not given | »1.7–4.4 (Ø 2.5)« | »1.0–2,9 (Ø 1.6)« | Malgarini 2014 |
| Les Hoteaux | UM | 49 [1] | 46 | 1.8–6.4 | 1.2–4.8 | Malgarini unpubl. |
| Parpalló | UM | 13 [3] | 35–80 | 1.9–5.1 | 1.5–3.4 | Borao 2022 |
| Cendres | UM | 13 [3] | 32–81 | 2.1–3.9 | 1.0–2.4 | Borao 2012; Borao 2013 |
| Cendres | M | 10 [2] | 23–38 | 1.4–3.6 | 1.1–2.3 | Borao/Villaverde unpubl. |
| Nerja | UM | 7 [1] | 62 | 2.7–7.0 | 0.9–2.0 | Aura et al. 2020; Aura et al. 2021 |

**Tab. 3** Morphometric attributes of Magdalenian bone needles from 14 assemblages in Southwest France and Spain. MM – Middle Magdalenian, MUM – Mid-Upper Magdalenian, UM – Upper Magdalenian, M – Magdalenian. Number in brackets – number of intact needles.

***Tab. 3*** *Morphometrische Merkmale von magdalénienzeitlichen Knochennadeln aus 14 Assemblagen in Südwestfrankreich und Spanien. MM – Mittleres Magdalénien; MUM – Mittleres Oberes Magdalénien; UM – Oberes Magdalénien; M – Magdalénien. Zahl in Klammern – Anzahl der intakten Nadeln.*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bones, cf. Fig. 7,6–7.10|). In some cases, bifacial grooving is used to extract rods on the edges of the ribs or on a bony crest (tibia, radio-ulna).

The blanks are detached by transverse sawing at the ends or by sawing and tearing. Sometimes, very long rods can be cut (at least) into two parts by sawing and bending or by *raclage en diabolo* and bending. The ends of the rods, often irregular, are detached with the same techniques.

The blanks are shaped by scraping (or by abrasion in rare cases, e.g. at Rigney Cave, Dép. Doubs; Malgarini 2014): removal of the spongiosa, creation of a point, and thinning of the future envisaged proximal part. During this initial shaping, the eye is made by bifacial perforation with generally a bi-conical morphology. A finishing phase can take place with the help of a polisher (sandstone or pumice) to reduce the last irregularities and obtain a better surface condition. Surface modifications (such as decoration) are rare on Magdalenian needles and usually take the form of transversal incisions on the proximal part, just distal to the eye (e.g. at La Vache, Dép. Ariège: Chauvière 2003b, at Parpalló: Borao 2022, or at Tastet Cave, Dép. Pyrénées-Atlantiques: cf. Fig. 7,7).

## Morphometry

The morphometric attributes of the Magdalenian bone needles are relatively constant. The objects usually have a circular or oval cross-section and straight sides. Data from 14 assemblages in Southwest France and Spain (Tab. 3) show that width generally varies between c. 1.5 and 4 mm (mean c. 2–3), thickness between c. 1 and 3 mm (mean c. 1.5–2), and length between c. 25 and 65 mm (mean c. 50 mm; for broadly similar figures, see also Stordeur 1979, 184; cf. Fig. 6,1–23). The shortest specimens are usually the result of resharpening (see below), and lengths c. 3 cm probably correspond to the minimum acceptable dimension for the use of the tool. D'Errico et al. (2018, 79) indicate that *»specimens from the Moravian Magdalenian are significantly wider than their French counterparts«*, but this does not appear to be supported by the published illustrations and scatterplot (d'Errico et al. 2018, Fig. 8 and S10), which show a wide overlap of the two populations in the 2–3.5 mm range for width. Similarly, the dimensional heterogeneity found by Treuillot on needles from La Madeleine, Dép. Dordogne (Treuillot 2012, 198), is probably due to the presence of both bone needles and antler bodkins in his sample (see below), as the author points out.

## Use, repair, and abandonment

The use of eyed needles in soft material assembly activities (essentially sewing) is characterised primarily by wear polishes on the surface of the artefacts. The fractures that affect most of the needles found in Magdalenian deposits – too systematic to be explained by post-depositional phenomena – are also indicative of how these objects functioned. These fractures concern either the eye or the shaft and point (with fracturing into three fragments, the so-called *»en nacelle«* fracture). After breakage, if needles are still long enough to be handled, they are repaired. These repairs may involve drilling a new eye in the immediate vicinity of the first one that has been broken. When the point is damaged, it can be resharpened by scraping. The scraping marks are clearly visible in this case, as the point is generally not re-polished. As a result, we are dealing with artefacts with very distinct surface finishes and parts that are shorter in length than they were originally.

## Bodkins: large antler needles

A group of large needles made of antler has been termed »bodkins« *(»alènes«)* to distinguish them from the more common type (cf. Fig. 6,30–34). Compared to the common type, bodkins have a different raw material – antler – and are of larger dimensions: according to measurements taken on fragments, their width varies between c. 3.5 and 5.5 mm (mean: 4.7 mm) and their thickness between c. 3 and 5mm (mean: 4.3 mm); the few complete and nearly complete specimens have lengths between c. 65 and 200 mm. They are often curved. The function of these infrequent objects might differ from that of the common, smaller bone needles (Bullinger et al. 2006, 142; Treuillot 2012, 198): one might interpret them as used in work requiring less precision. They are only known from some sites in Southwest France and in one part of the Magdalenian chronology. They might be present in the Early Lower Magdalenian (Lascaux, Dép. Dordogne: Chauvière et al. in press). They are known in the Late Lower Magdalenian (Saint-Germain-la-Rivière, Dép. Gironde, *»ensemble inférieur«*, perhaps Gabillou, Dép. Dordogne: Langlais et al. 2015, 27; Langlais et al. 2023, 75), in the Early Middle Magdalenian (Roc-de-Marcamps, Dép. Gironde, and Moulin-Neuf, Dép. Gironde, Marsoulas, Dép. Haute-Garonne: Kuntz et al. 2015, 492; J.-M. Pétillon pers. obs.), and in mixed assemblages that include material from the Early Middle Magdalenian (Les Harpons B-C, Dép. Haute-Garonne: J.-M. Pétillon, pers. obs.; Reverdit, Dép. Dordogne: Bourdier et al. 2014, 443; perhaps Le Placard, Dép. Charente, given the dimensions in Stordeur 1979, 185–186; and Solutré-Route de la Roche, Dép. Saône-et-Loire, Malgar-

**Fig. 6 (left page)** Sample of Magdalenian needles and bodkins. 1–29: bone; 30–34: antler. Early Lower Magdalenian: 1 Taillis des Coteaux EG-III. Late Lower Magdalenian: 2–3 Saint-Germain-la-Rivière lower stratigraphic unit. Early Middle Magdalenian: 4–6 Combe-Cullier UA4; 7 Tastet Cave US315. Late Middle Magdalenian: 8 Tastet Cave US308a; 9–14 Saint-Michel d'Arudy. Early Upper Magdalenian: 15–16 Combe-Cullier UA1b. Late Upper Magdalenian: 17–18 Combe-Cullier UA1a; 19–23 Peyrazet. Blanks and waste products of shaping: 24–25 Houleau (Early Lower Magdalenian); 26–29 Peyrazet (Late Upper Magdalenian). Antler bodkins: 30–31 Marsoulas; 32–34 Les Harpons B–C.

***Abb. 6 (linke Seite)*** *Beispiele für magdalénienzeitliche Nadeln und Haarnadeln. 1–29: Knochen; 30–34: Geweih. Frühes Älteres Magdalénien: 1 Taillis des Coteaux EG-III. Spätes Unteres Magdalénien: 2–3 Saint-Germain-la-Rivière ensemble inférieur. Frühes Mittleres Magdalénien: 4–6 Combe-Cullier UA4; 7 Tastet-Höhle US315. Spätes Mittleres Magdalénien: 8 Tastet-Höhle US308a; 9–14 Saint-Michel d'Arudy. Frühes Oberes Magdalénien: 15–16 Combe-Cullier UA1b. Späteres Oberes Magdalénien: 17–18 Combe-Cullier UA1a; 19–23 Peyrazet. Rohlinge und Abfallprodukte der Formgebung: 24–25. Frühes Unteres Magdalénien: Houleau; 26–29. Späteres Oberes Magdalénien: Peyrazet. Geweihhaarnadeln: 30–31 Marsoulas; 32–34 Les Harpons B–C.*

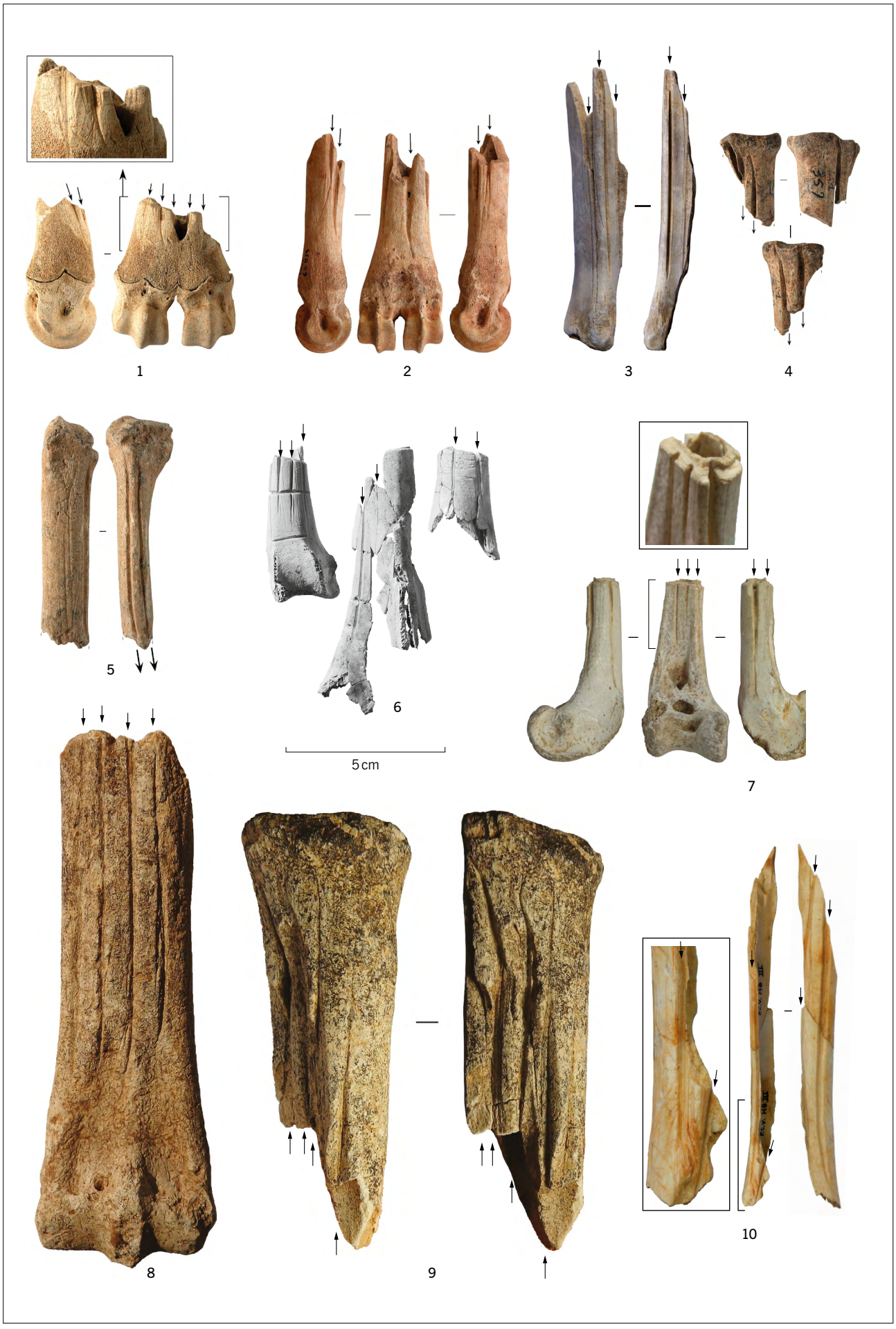
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**Fig. 7 (left page)** Sample of Magdalenian waste products of manufacture of rods (needle blanks) with the groove and splinter technique. 1 Peyrazet, reindeer metatarsal; 2 Roc-de-Marcamps, reindeer metapodial; 3 La Croze, reindeer metapodia; 4 Saint-Germain-la-Rivière, upper stratigraphic unit, saiga antelope metacarpal; 5 Saint-Germain-la-Rivière, lower stratigraphic unit, bear metatarsal; 6 Monruz, swan tibiotarsus and humerus (Müller 2013); 7 Grotte des Romains, swan humerus; 8–9 Solutré *Route de la Roche,* horse metapodial; 10 Grotte des Romains, eagle tibiotarsus.

***Abb. 7 (linke Seite)*** *Beispiele von Abfallprodukten aus dem Magdalénien, die bei der Herstellung von Stäbchen (Nadelrohlingen) mit der Rillen- und Splittertechnik anfielen. 1 Peyrazet, Rentiermetatarsal; 2 Roc-de-Marcamps, Rentier-Metapodien; 3 La Croze, Rentier-Metapodium; 4 Saint-Germain-la-Rivière, obere stratigrafische Einheit, Mittelhandknochen einer Saigaantilope; 5 Saint-Germain-la-Rivière, untere stratigrafische Einheit, Mittelfußknochen eines Bären; 6 Monruz, Unterschenkelknochen und Humerus eines Schwans (Müller 2013); 7 Grotte des Romains, Humerus eines Schwans; 8–9 Solutré* Route de la Roche, *Pferdmetatarsal; 10 Grotte des Romains, Unterschenkelknochen eines Adlers.*

ini unpubl.). They seem to disappear in the later stages of the Magdalenian (but see Treuillot 2012, 198 for La Madeleine, and Bullinger et al. 2006, 142 for Monruz).

## Discussion and conclusions

Indirect evidence of clothing production has been discovered at Palaeolithic sites around the globe. Various lithic and osseous tools associated with processing hides and plant fibres have been found throughout the Palaeolithic. The osseous toolkit related to this activity includes smoothers, awls and possibly *épingles* and double points. Still, the eyed needle is the technological innovation that unequivocally marks the beginning of intricate sewing in the Palaeolithic.

Throughout the Upper Palaeolithic, eyed needles were used for sewing with different materials, such as sinews or plant fibres. These needles made it possible to sew garments, backpacks, or shoes and even to decorate them with ornaments and applications. The use and reuse of this tool have been observed through both use-wear traces and repairs of the perforation and distal end, the latter attesting to an object that has been used so intensively that it can no longer be deployed.

Eyed needles originated in the Altai and the Caucasus and initially spread throughout Central and East Russia and China. Their appearance has been attributed to the harsh climatological conditions of that area, which in turn led to the need for complex clothing and, consequently, the creation of complex technology such as eyed needles.

Technological studies allow us to compile »cultural maps« and propose hypotheses about knowledge dispersion and its variability or on the contrary, a new technological innovation. In this sense, the scarce information published on those first eyed needles points to a kind of technical uniformity (GST) but a high variability in size, for example, as in the Yana RHS site in Siberia (Fedorchenko/Belousova 2021; Pitulko et al. 2012). This could either indicate that the production is not standardised or suggest a diversity of functions.

Three aspects have been taken as a reference for situational convergences that give rise to the independent origin proposed for the eyed needle: the technological context of the lithic industry, the morphometry of the needles (fundamentally the cross-section morphology), and the technology employed in the manufacture of eyed needles.

The appearance of eyed needles in Europe, at the Kammern-Grubgraben site (23.7–22.4 ka cal BP), and the Badegoulian sites (23.5–20.5 ka cal BP), is currently under consideration: on the one hand, because needles in Solutrean contexts are disputed and discussed as more plausibly attributed to the Badegoulian or the Magdalenian, and on the other, because of a possible independent origin of needles. The lithic industry during the Badegoulian is based on core and flake technology, and the technical traits involved in eyed needles' manufacture differ from those identified in Asia and East Europe, where GST is absent and they are produced by fracturing. A high morphometric variability accompanies this condition.

On this basis, in the case of China, with the arrival of lithic industries typical of Anatomically Modern Humans (micro-core and microblade industries), the morphology of the needle section changes and becomes more similar to specimens found in other regions of the continent. However, this situation changes in the Late Glacial with a process of regionalisation where the lithic industry is based on core and flake technology and a change in needle manufacture based on longitudinal splitting at the Shuidonggou loc. 12 site coincides with the Younger Dryas (YD). These situational convergences led to the proposal of an independent origin of innovation for the needles (Doyon 2019; d'Errico et al. 2018). With all this evidence, if we consider that the convergence of harsh climatic conditions (LGM [Last Glacial Maximum] or YD), a lithic industry based on flake technology, and a needle manufacture by percussion techniques refer to independent origins, then the Badegoulian would, indeed, mark an independent origin. However, we still do not have enough arguments for this affirmation or for the relation between the technological traits from Kammern-Grubgraben and the Badegoulian ones, although a possible origin of the Badegoulian in that area has been suggested.

The Magdalenian Culture in Europe shows technological homogenisation with the rest of Eurasia. Multiple parallel grooving points to standardised production, although size variability exists and could be due to diverse functional purposes.

Finally, the appearance of eyed needles in North America with a new climatic crisis (YD) is characterised technologically by the GST and a limited range of width (most of the needles are just fragments), making these the smallest examples – only comparable with the smallest Magdalenian needles from Moravia, France and Spain (d'Errico et al. 2018). The origin of this tool in North America is being discussed: an independent origin has been suggested as a consequence of the YD conditions (Pelton et al. 2024), but the hypothesis held so far is that the populations that crossed the Bering Strait carried this technology with them (d'Errico et al. 2018).

Regarding morphometry, its diversity could be analysed from two perspectives: the technological and the functional. Regarding technology, the use of the GST shows higher standardisation, while the use of percussion tech-

niques could be related to a higher disparity. The fact is that the variability in length exists independently of the techniques employed, so it must be related to functional purposes, especially when we find the use of other raw materials, such as antler in the case of bodkins.

As for the raw material used in the needles' manufacture, bone is the most common, although we can also find specimens in antler and ivory. The long bones of the selected species are those most consumed, including, for example, horse, reindeer, and ibex: species that vary according to ecological niche. However, we observe the use of small-sized species such as *Leporidae*, and small carnivores and birds in different parts of the planet, showing a certain versatility of these human groups and their use of all available resources.

What is certain is that, despite all the evidence for the presence of eyed needles and, in some cases, of their by-products, the question of their presence in some archaeological contexts continues to be affected by problems such as taphonomy, excavation methodology, or the absence of sieving. These problems result in a low representation of this tool in the assemblages or the likelihood of its presence outside its original context, such as the Solutrean or the Azilian. In this sense, the existence of by-products is key to identifying not only how needles were made but also whether they belong to a specific archaeological level. Nevertheless, direct dating would be the most direct and unequivocal way to resolve this question; since it is not currently possible, we must continue to depend on the context.

## Acknowledgements

Funding: This work was funded by the APOSTD/2021/052 grant from the Generalitat Valenciana and European Social Funds, with María Borao Álvarez as the beneficiary.

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## Source of figures

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# Reverse engineering of sewing with needle-and-thread: an interpretation of complementary technology at Aghitu-3 Cave, Armenia

Andrew W. Kandel, Boris Gasparyan, Ani Adigyozalyan, and Miriam N. Haidle

**Zusammenfassung**

Reverse Engineering des Nähens mit Nadel-und-Faden: eine Interpretation komplementärer Technologie in der Aghitu-3-Höhle, Armenien

*In diesem Beitrag dekonstruieren wir ein einzelnes Fundstück aus der Höhle Aghitu-3 im armenischen Hochland und ordnen es in einen breiteren Verhaltenskontext ein. Bei dem besagten Fund handelt es sich um eine Knochennadel mit Öhr aus dem archäologischen Horizont IIId, einer jungpaläolithischen, etwa 29 000 Jahre alten Schicht. Durch sog.* Reverse Engineering *der zahlreichen Prozesse, die mit der Herstellung und Verwendung dieses Fundstücks verbunden sind, erhalten wir einen Einblick in die Interaktion des frühen modernen Menschen mit seiner Umwelt. Zu diesen Prozessen gehören die Herstellung von Stein- und Knochenwerkzeugen, die Bearbeitung von Häuten, die Verarbeitung von Fasern, das Zusammensetzen von Kleidungsstücken und deren Verzierung mit Muscheln.*

*Die Menschen des Jungpaläolithikums verwendeten in einer sog.* Community of Practice *ein Netzwerk aus breitem Wissen und Know-how, verschiedenen Praktiken, Rohmaterialien, Halbfertigprodukten und Werkzeugen. Mithilfe des Kognigramm-Ansatzes stellen wir fest, dass der Fund einer Nadel mit Öhr als ›Nadel-und-Faden‹ gelesen werden muss – als komplementäres Werkzeugset, dessen zwei getrennte und auswechselbare, aber voneinander abhängige Elemente miteinander interagieren, konzeptionell vergleichbar mit Pfeil-und-Bogen. Ein spezifisches Merkmal dieses Werkzeugsets ist die Übertragung seines Verbrauchsteils, des Fadens, durch den unterstützenden Teil, die Nadel, auf die zugeschnittenen Teile aus Leder oder Stoff. Dadurch entsteht ein zusammengesetztes Artefakt, ein Komposit mit neuen Eigenschaften, die über die der Grundelemente hinausgehen. Der hier angewandte deduktive Ansatz hilft, den verborgenen Makrokosmos hinter einem exemplarischen archäologischen Fund zu verstehen.*

**Schlagwörter** Jungpaläolithikum, Knochennadel mit Öhr, Knochenwerkzeuge, Muschelperlen, Kognigram

**Summary**

*In this paper, we deconstruct a single find from Aghitu-3 Cave in the Armenian Highlands and expand it within a broader behavioural context. The find in question is an eyed bone needle from archaeological horizon IIId, an Upper Palaeolithic layer dated to about 29 000 years ago. By reverse engineering the numerous processes associated with the manufacture and use of this find, we gain insight into how early modern humans interacted with their environment. Such processes include the production of stone and bone tools, hide working, processing fibres, assembling garments, and decorating with shells.*

*In a community of practice, Upper Palaeolithic humans applied a network of broad knowledge and know-how, diverse practices, raw materials, semi-finished products, and tools. Using the cognigram approach, we assert that the find of an eyed needle must be read as needle-and-thread, a complementary tool set whose two separate and exchangeable, yet interdependent elements interact with each other, conceptually comparable to a bow-and-arrow. A specific characteristic of this tool set is the transfer of its consumable part, the thread, through the enhancing part, the needle, to the tailored pieces of leather or fabric. This creates a composite artefact with new emerging qualities beyond those of the basic elements. The practice of deduction used here helps us understand the hidden macrocosm behind an exemplary archaeological find.*

**Keywords** Upper Palaeolithic, eyed bone needles, bone tools, shell beads, cognigram

## Introduction

Evidence for the manufacture and use of clothing in the Palaeolithic is rare. Its importance for the year-round survival of humans under Ice Age conditions from Central Europe to East Asia, and in particular for the expansion of humans beyond 50° of northern latitude, is undisputed. Here, our research group aims to contribute one facet to the study of Upper Palaeolithic sewing based on our work at an archaeological site named Aghitu-3 Cave, where we began

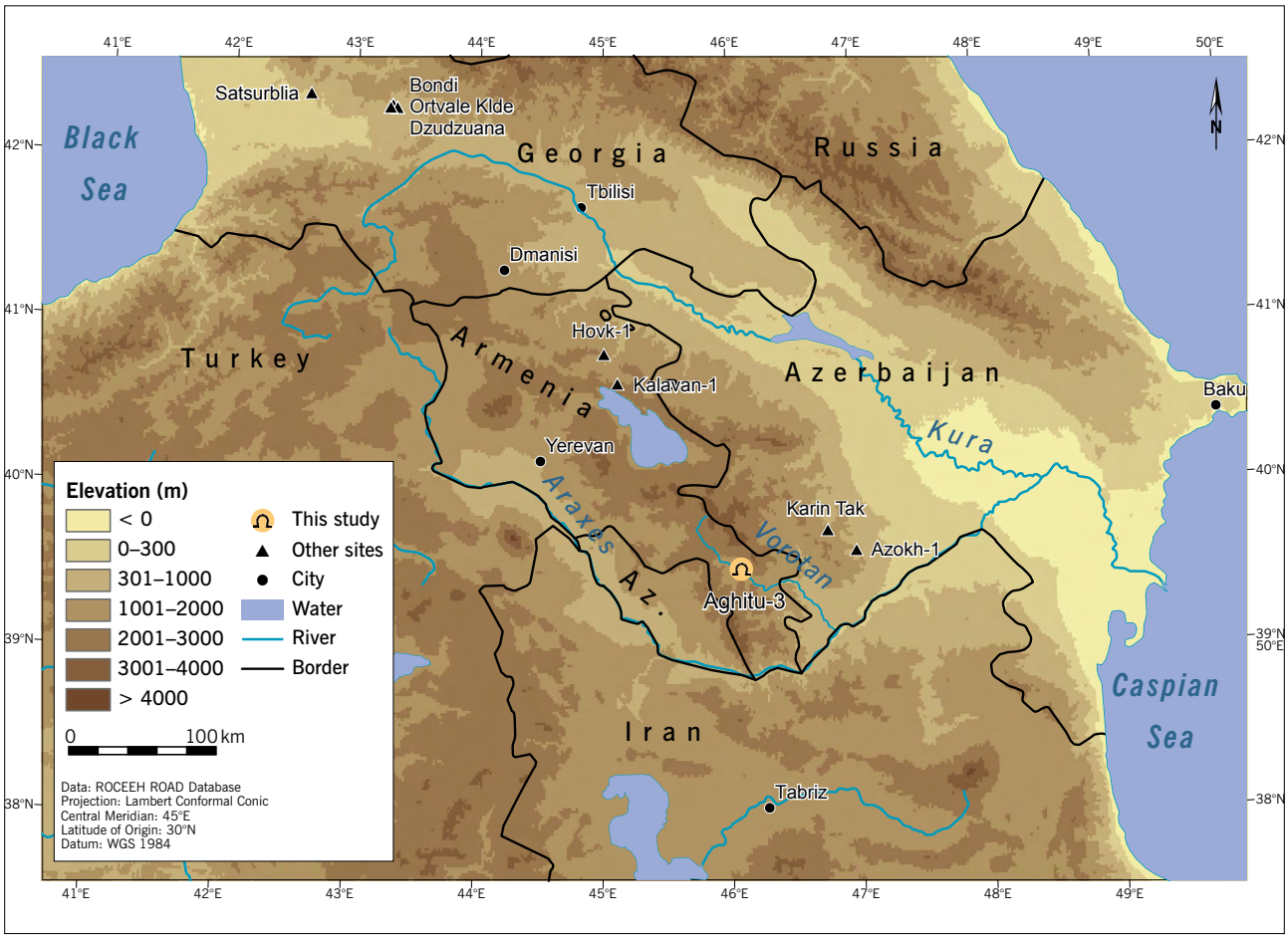



**Fig. 1** Location of Aghitu-3 Cave, Syunik Uplands, in the Armenian Highlands showing its relationship to regional archaeological sites.

***Abb. 1*** *Lage der Aghitu-3-Höhle, Hochland von Syunik, im armenischen Bergland mit Darstellung ihrer Beziehung zu regionalen archäologischen Fundstellen.*

excavations in 2009. The site is located in the Syunik province in southern Armenia at an elevation of 1601 m and a latitude of N 39.5° (Fig. 1–2). The stratigraphic sequence of the site provides a remarkably detailed record of human habitation during the Upper Palaeolithic, covering the period from 40 000 to 24 000 years ago. One exceptional find is an eyed bone needle found in archaeological horizon (AH) IIId, which dates to about 29 000 years ago based on calibrated radiocarbon dates of charcoal and bone (Kandel et al. 2017).

We hope this article succeeds in illustrating how a simple needle can open a much larger web of understanding about Palaeolithic life. We use details about the site and augment them with information taken from a broader archaeological context to reconstruct the process of making clothing with a needle. Using the cognigram approach, we emphasise the function of needle-and-thread as a specific, complementary tool set. By doing so, we explore the world that the needle reveals, Upper Palaeolithic lifeways in general, clothing, and technological sophistication in particular. By reverse engineering the many processes involved in making and using the needle, we aim to establish a greater connection between the material remains discovered at this archaeological site and the everyday activities of Upper Palaeolithic people.

## Bone tools for sewing

Archaeologists distinguish two groups of bone tools which they associate with sewing. On the one hand, awls are pointed tools without an eye for threading. They are generally made of animal limb bones, either naturally pointed ones or elongated shafts. The pointed distal ends were shaped and maintained during their use by whittling and grinding, whereas the proximal ends may not be modified at all. Use-wear of the tips of such tools indicates that already in late Neanderthal contexts, awls were heavily used to puncture soft tissues such as hides and leather (d'Errico et al. 2003). These pointed tools, potentially in combination with puncture boards (Doyon et al. 2023), are perfectly well suited for making different kinds of clothing on their own.

On the other hand, eyed needles (e.g. Gilligan 2019), as their name suggests, possess a perforation that allows the threading of different kinds of fibres. In the combined process of puncturing and pulling threads through the perforations, these tools can be used for different sewing purposes such as stitching layers together and attaching ornaments to clothing, but also for weaving, netting, and basketry, among other possibilities. Eyed needles are generally made from fragments of long bones that have been worked all over. Needles for sewing are significantly smaller and thinner than

**Fig. 2** Aghitu-3 Cave in 2008 before excavation began. The opening of this basaltic cave is about 18 m wide, 11 m deep, and 6 m high.

***Abb. 2*** *Die Aghitu-3-Höhle im Jahr 2008 vor Beginn der Ausgrabungen. Die Basalthöhle ist etwa 18 m breit, 11 m tief und 6 m hoch.*

awls, and their use is different, enabling finer detailed work. Even though awls and eyed needles are both clearly associated with the production of clothing and accessories, experimental archaeologists readily agree that such tools are in no way prerequisites for making clothing (D. Olthoff, pers. comm.; Klek 2012; see IJsveld/Olthof in this volume).

Two synthetic studies over the past decade have advanced our understanding of when eyed needles first came into use and where they occurred. At the heart of these studies is the investigation of needles and their relationship to tailored clothing. F. D'Errico et al. (2018) brought together a list of global sites showing that the earliest eyed needles occurred in Asia about 45 000 years ago. These were associated with the Early Upper Palaeolithic of the Caucasus and Central Siberia. I. Gilligan et al. (2024) furthered this trend by expanding the list of sites with needles between c. 45 000 and 25 000 years ago, as the technology became established in Asia.

The archaeological evidence for eyed needles is surprisingly rare. Worldwide, fewer than 20 localities are currently known from the period between 45 000 and 25 000 years ago, and these are scattered widely across Asia. As we see in Fig. 3, eyed needles first appear at two locations in Central Asia between 45 000 and 35 000 years ago and expand across Asia in two steps from 35 000 to 25 000 years ago. The first step reaches Central and Eastern Asia, while the second spreads into Western Asia. Two additional sites, one in Slovenia and the other in Spain, suggest that eyed needles arrived in Europe after 30 000 years ago (Gilligan et al. 2024). Following this initial phase of development, eyed needles become more frequent in the archaeological record of Eurasia during the Last Glacial Maximum (LGM, c. 26 000 to 20 000 years ago). Only after the LGM at the end of the Palaeolithic (18 000–14 000 years ago) did they become a common feature of archaeological sites all over Eurasia (Stordeur-Yedid 1979; Lázničková-Galetová 2010; Zhang et al. 2016).

One of the oldest eyed bone needles stems from Denisova East Chamber in the Altai Mountains of Siberia (Russia). Even though it is broken at the tip and the eyelet, it measures 52.6 mm long, 2.0–2.5 mm wide, and 2.2–1.1 mm thick; the preserved part of the eyelet is 0.8 mm in diameter (Shunkov et al. 2020). Another outstanding assemblage of eyed needles comes from the Yana site in the far north of Siberia. The Yana needles show various shapes with a length spanning from less than 50 to more than 100 mm and apparently different cross-sections. The thickness of the proximal part ranges from 2.0–2.5 up to 7.9 mm, a span that defines the maximum hole size left in the fabric that was worked with these implements. The needles and fragments from Yana

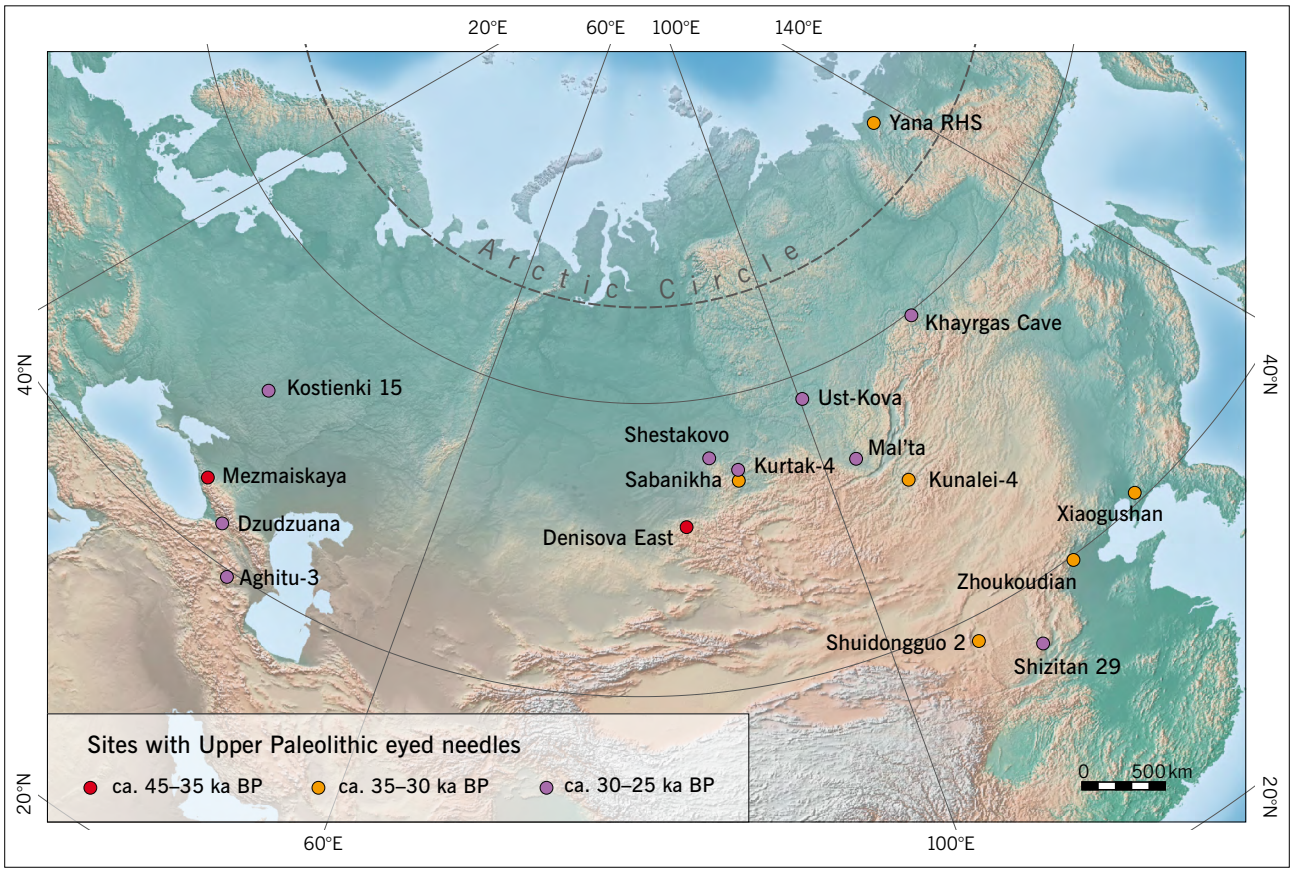



**Fig. 3** Mapping of Upper Palaeolithic eyed bone needles in Asia showing the progression of their distribution over time.

***Abb. 3*** *Kartierung jungpaläolithischer Knochennadeln mit Öhr in Asien, die die chronologische Verbreitung zeigt.*

indicate that these tools were extensively used and maintained by reshaping the tips and drilling new eyes (Pitulko/Pavlova 2022).

With a length of 18.5 mm and a width of 2 mm, the eyed bone needle from Aghitu-3 is considerably smaller than those of the Denisova and Yana assemblages. Part of the needle's eyelet and point were missing, suggesting it was discarded in a broken state. Thus, the full length of the needle is not known. Similar to the sites mentioned above, its eye is less than 1 mm in diameter (Fig. 4). The find truly represents the proverbial needle in a haystack, found through meticulous sieving and sorting of each bucket of sediment during the excavation. Even though the needle is incomplete, we can learn much about past human behaviour from this exceptional artefact.

Since needles are quite small, it is seldom possible to identify the animal species to which the bone belonged. Relatively recent and innovative analytical methods such as ancient DNA and ZooMS (Zooarchaeology by Mass Spectrometry) make it possible to identify the species used to make needles (Pelton et al. 2024). Still, it is not customary to subject such small and rare objects to destructive forms of testing, so for now we cannot say from which animal the needle at Aghitu was fabricated. Nor could we carry out microscopic studies to better understand how the needle was made or used. However, based on macroscopic observations, we can say that the needle shows traces of whittling as well as polish, likely from manufacture and use.

## The site of Aghitu-3 Cave

The cultural layer AH IIId, in which the needle was found, yielded over 3000 stone artefacts made of obsidian and chert. The approach to knapping focused on creating cores and knapping them from a single direction, so-called unidirectional bladelet cores (Fig. 5,1). Many of the blanks were then modified by retouching the edges to form differently shaped tools. Most of the tools at Aghitu consist of laterally retouched and backed bladelets (Fig. 5,4–9), suggesting that people focused on preparing hunting equipment. In addition, some of the tools were further modified into drills, which would have been helpful in perforating bone. Other tools include scrapers (Fig. 5,2) and burins (Fig. 5,3), as well as notches and denticulates (Kandel et al. 2017).

Using portable X-Ray Fluorescence (pXRF) to differentiate the obsidian sources, the team determined that about 8% of the obsidian present in AH III at Aghitu-3 travelled long distances, up to 250 km, to get there (Kandel et al. 2017; Frahm et al. 2019). Such studies show us that people were highly mobile, or at least had contact with other groups who ranged over equally broad territories. Most of the obsidian (~92%) was found within the nearby Vorotan River basin from sources up to 30–40 km away.

More than 1400 animal bones come from layer AH IIId, mainly of equids (horse) and caprines (sheep/goat) (Kandel et al. 2017; Bertacchi et al. 2021). The faunal remains are associated with the stone artefacts and tell us what animals the

**Fig. 4** Eyed bone needle from Aghitu-3 Cave, layer AH IIId, measuring 1.85 cm in length and 0.2 cm in maximum width, broken at base and point.

***Abb. 4*** *Knochennadel mit Öhr aus der Aghitu-3-Höhle, Schicht AH IIId, 1,85 cm lang und 0,2 cm breit, an Basis und Spitze abgebrochen.*

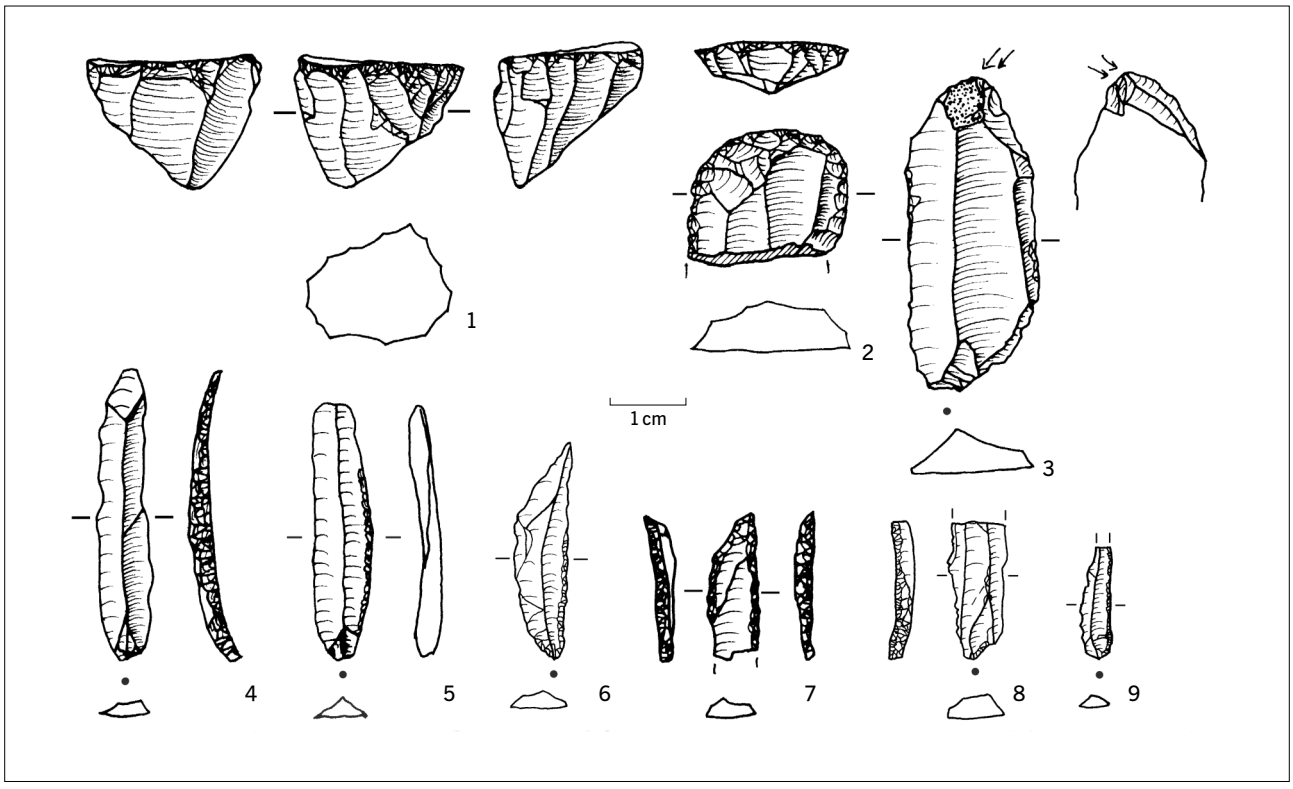



**Fig. 5** Examples of stone artefacts made of obsidian and chert from Aghitu-3 Cave, layer AH III: 1 core; 2 scraper; 3 burin; 4–9 retouched bladelets.

***Abb. 5*** *Beispiele für Steinartefakte aus Obsidian und Silex aus der Aghitu-3-Höhle, Schicht AH III. 1 Kern; 2 Kratzer; 3 Stichel; 4–9 retuschierte Lamellen.*

**Fig. 6** Complete pointed bone awl from Aghitu-3 Cave, layer AH IIId, measuring 12 cm in length and 1.1 cm in maximum width.

***Abb. 6*** *Vollständige spitze Knochenahle aus der Aghitu-3-Höhle, Schicht AH IIId, 12 cm lang und maximal 1,1 cm breit.*

**Fig. 7** Bone point from Aghitu-3 Cave, layer AH IIId, measuring 10.9 cm in length and 0.5 cm in width, with broken base.

***Abb. 7*** *Knochenspitze aus der Aghitu-3-Höhle, Schicht AH IIId, 10,9 cm lang und 0,5 cm breit, mit abgebrochener Basis.*

inhabitants of Aghitu hunted and ate. The age of the animals and their state of tooth wear helps us to determine that the site was likely occupied during the warmer seasons, probably in spring and early summer. In addition to the eyed needle, further organic artefacts from AH IIId include a bone awl (Fig. 6) and a bone point (Fig. 7). We interpret several perforated shell beads (Fig. 8) made from the freshwater snail *Theodoxus pallasi* as ornaments, in some cases stained with ochre residues.

Evidence from microarchaeological studies indicates that AH III contains complex combustion features (Kandel et al. 2017). This supports prolonged and repeated occupations at the site. Additionally, a wide array of scientific analyses covering sedimentary ancient DNA (ter Schure et al. 2022), micromammals (Rey-Rodríguez et al. 2024), isotopes, charcoal, and pollen, among other categories, have contributed to synthetic studies about the regional climate and environment between 40 000 and 24 000 years ago (Kandel et al. 2017).

## Reverse engineering of sewing with needle-and-thread

By reconstructing the activities associated with and examining the ideas that stand behind the tiny bone needle, we start to understand how a superficially simple artefact can encompass an entire world of entangled humans, their knowledge and practices, raw materials, semi-finished products, and tools (cf. Hodder 2011). In addition to the sphere of the eyed needle and the other bone tools, its context comprises the spheres of different lithic tools, hides/leather (or fabric), fibres/thread, the assemblage of the garment, and its decoration (for summary see Tab. 1).

### Lithic tools

Different lithic tools for cutting, whittling, drilling, and grinding are prerequisites for manufacturing highly modified bone tools such as awls, lissoirs, and especially needles. Raw materials with adequate qualities for modification and use must first be acquired. Tools to knap the desired tool forms, such as burins, scrapers, notches, denticulates, or drills, comprise unmodified hammerstones and bone retouchers. All types of cutting stone tools are present among the finds of AH IIId and are made of obsidian and chert.

### Bone tools

To make a needle as well as other bone tools, a person first had to collect an animal bone from a fresh carcass – perhaps

**Fig. 8** Examples of perforated shell beads of the freshwater gastropod, *Theodoxus pallasi*, from Aghitu-3 Cave, layer AH III.

***Abb. 8*** *Beispiele für durchlochte Muschelperlen der Süßwasserschnecke* Theodoxus pallasi *aus der Aghitu-3-Höhle, Schicht AH III.*

hunted, perhaps scavenged. Flat ribs were taken as blanks for producing lissoirs (Soressi et al. 2013), and fragments of diverse bones could be used with minimal modification as retouchers. For awls and needles, people usually selected long limb bones; tibias and metapodials were favoured to produce needles because these bones are naturally straight and solid. Sharp stone tools like burins (Fig. 5,3) were needed to extract the blank of the needle from the long bone. With these, parallel grooves could be cut into the bone to prepare the basic elongated pre-form of the needle (Hoffman 2002; Lázničková-Galetová 2010; Fig. 9). Freed from the bone, the blank was probably carved into its desired shape using flakes or retouched pieces such as scrapers, notched artefacts, or denticulates. After thinning the butt end, a pointed stone drill was needed to pierce the bone from both sides to create the eyelet. The needle was then smoothed, perhaps on a grinding stone or another flat hard surface using sand or grit as an abrasive, until the desired roundness and smoothness were achieved. Finally, the tip was sharpened through abrasion.

## Hide/leather

Needles are tools used to join pieces of textiles or treated animal skins. As one possibility in the macrocosm of a needle with an eyelet, we concentrate here on the processing of hides and leather as an example. From Palaeolithic contexts, we know little about the techniques and materials used to transform fresh animal skin into durable and wearable hides or leather. Ethnographic and experimental work provides insights into potential fabrication processes (Hurcombe 2014; Klokkernes 2022). Raw skin or a pelt must be acquired by hunting; its qualities differ significantly depending on animal species, the season of the hunt, the sex and age of the prey, and the part of the body. The best quality can be gained in late summer to autumn when holes made by insects such as eclosing botflys are healed and the fresh winter pelt is grown (Osborn 2014); the occupation of Aghitu-3 in spring and summer makes the processing of hides at another location plausible.

| | Activity | Raw material | Tools used | Product | Tool behaviour (Haidle et al. 2015) | Reference |
|---|---|---|---|---|---|---|
| Stone tools | acquisition | lithic with flaking qualities | – | – | – | |
| | acquisition | lithic with grinding qualities | – | – | – | |
| | acquisition | pebble as hammer stone | – | – | – | |
| | knapping | lithic with flaking qualities | hammer stone, bone retoucher | cutting stone tools such as burins, scrapers, notches, denticulates, drills | simple | |
| Bone tools | acquisition | bone of different shape for retoucher, lissoir, punch board, awl and needle | – | – | – | |
| | acquisition | polishing material | – | – | – | |
| | whittling and grinding, polishing | long bone | cutting stone tool like scraper and grinding stone, polishing material | awl | simple | Pitulko/Pavlova 2022 |
| | incising, thinning and reshaping by whittling and grinding, polishing, drilling | long bone | different cutting stone tools (like burin, scraper, notch, denticulate), drill, grinding stone, polishing material | eyed needle | simple | Pitulko/Pavlova 2022 |
| | thinning and reshaping by grinding | rib | grinding stone | deflesher/lissoir with smooth ogival tip | | Soressi et al. 2013 |
| Additional | unspecified | unspecified | unspecified | equipment like hunting weapons, containers, frames, sewing patterns | simple, potentially **composite** or **complementary** | Haidle 2009; Lombard/Haidle 2012 |
| Hides/leather | acquisition/hunt | prey | hunting weapons, cutting stone tool | raw skin | simple, potentially **composite** or **complementary** | Haidle 2009; Lombard/Haidle 2012 |
| | drying (or smoking), cleaning: removal of remaining meat, fat and connecting tissues, optional removal of hair | raw skin | possibly fire, cutting stone tool, stone scraper or bone deflesher/lissoir (smoother), hard ground or frame | stabilised raw skin | simple | Hurcombe 2014, 81; Klokkernes 2022 |
| | acquisition | tanning substance: brain, urine, vegetable or bark, smoke, oil, ochre | possibly container, cutting or pounding stone tool, water, fire, smoking fuel | – | simple | Hurcombe 2014, 80–87; Klokkernes 2022 |
| | tanning, rinsing, softening/oiling | tanning substance, stabilised raw skin | possibly container, water, lissoir (smoother) | tanned and soft hides | **compound** | Hurcombe 2014, 80–87; Klokkernes 2022 |

| | Activity | Raw material | Tools used | Product | Tool behaviour (Haidle et al. 2015) | Reference |
|---|---|---|---|---|---|---|
| Fibres/thread | acquisition | fibre plants (flax, nettle, bast of trees) | possibly cutting stone tool, bark peeler | – | none or simple | |
| | extracting fibres, cleaning, aligning | fibre plants (flax, nettle) | possibly pounding tool such as wooden mallet, water/dew or scraper | fibres | simple | Hurcombe 2014, 56–57 |
| | acquisition | dye plant | possibly cutting stone tool | – | none or simple | |
| | preparation | dye plant | possibly container, water, pounding tool | dye | simple | |
| | dying | dye fibres | possibly container | dyed fibres | **compound** | Hurcombe 2014, 66–67 note 28 |
| | spinning, plying, twisting | dyed plant fibres | – | thread | – | Jørgensen et al. 2023 |
| Assembling garment | tailoring according to patterns and wearer | tanned hides | cutting stone tool | tailored pieces of tanned hide | simple | |
| | punching | tailored pieces of tanned hide | awl and punch board | tailored pieces of tanned hide with holes for seam | simple | Doyon et al. 2023 |
| | sewing | tailored pieces of tanned hide (with holes?) | eyed needle-and-thread | garment | **composite, complementary** | Osborn 2014; Siebrecht et al. 2023; Nomokonova et al. 2024 |
| Decoration | acquisition | (shells of) freshwater snails | – | – | – | |
| | cleaning from animal tissue and dirt (optional) | (shells of) freshwater snails | potentially twig as probe; fire; water | clean shells | simple | |
| | perforation (optional) | shells | stone tool for drilling or grinding | perforated shells | simple | |
| | application according to patterns | perforated shells, garment | eyed needle-and-thread | garment with ornaments | **composite, complementary** | |

**Tab. 1** The context of the eyed bone needle comprises various spheres including stone and bone tools, hides/leather (or fabric), fibres/thread, the assemblage of the garment, and its decoration. This table summarises the respective activities, raw materials, tools used, products, and tool behaviour related to making an eyed bone needle.

***Tab. 1*** *Der Kontext der Knochennadel mit Öhr umfasst verschiedene Bereiche, darunter Stein- und Knochenwerkzeuge, Häute/Leder (oder Stoff), Fasern/Faden, die Zusammenstellung des Kleidungsstücks und seine Verzierung. Die Tabelle fasst die jeweiligen Tätigkeiten, Rohstoffe, verwendeten Werkzeuge, Produkte und das Werkzeugverhalten im Zusammenhang mit der Herstellung einer Knochennadel mit Öhr zusammen.*

In the first step, the raw skin – laid on the bare ground or stretched in a frame – must be cleaned of meat, fat, and connecting tissues with the help of stone or bone tools and then dried or smoked to prevent rotting. For the tanning process, two additional components are needed: 1) substances such as brain, urine, extracts from vegetables or bark, smoke, oil, or ochre; and 2) a variety of implements including containers, cutting and pounding tools, and fire plus smoking fuel as material (Hurcombe 2014; Klokkernes 2022). During the tanning process, the raw skins are infused by the tanning substance: both form an inseparable compound material with new qualities, which can then be further processed into products such as garments, bags, and tents.

## Fibres/thread

To join pieces of textiles or treated animal skins, materials of animal origin such as tendons, sinew, or leather strips can be used; alternatively, various plant fibres can serve as

**Fig. 9** Example of an eyed bone needle made experimentally from the tibia of a juvenile pig.

***Abb. 9*** *Beispiel einer experimentell hergestellten Knochennadel mit Öhr aus dem Schienbein eines jungen Schweins.*

thread in the sewing process. In contrast to the lack of data about hide-working, some (sparse) evidence in Palaeolithic contexts sheds light on the processing of plant fibres.

From a Neanderthal context at Abri Maras, Dép. Ardèche (France), dating between 52 000 and 41 000 years ago, we recognise potential remains of z-twisted, three-ply thread made from the fibrous layer of the inner bark (bast), likely of conifers (Hardy et al. 2020). An ivory baton with grooved holes from the southern German site of Hohle Fels, Alb-Donau-Kreis District, implies that people were making rope about 35 000 years ago (Conard/Malina 2016; Conard/Rots 2024). From the Georgian site of Dzudzuana in the southern Caucasus, we see evidence for spun, twisted, and dyed flax fibres about 29 000 years ago (Kvavadze et al. 2009; Bar-Yosef et al. 2011), contemporaneous with the occupation of AH IIId at Aghitu-3. Sedimentary ancient DNA studies at Aghitu-3 revealed evidence of plants that provide dyes and fibres, strengthening previous findings about Upper Palaeolithic plant use in this region (ter Schure et al. 2022). From Pavlovian contexts in Moravia, the use of plant fibres dating between 32 000 and 29 000 years ago has been reported (Adovasio et al. 2001). At Dolní Věstonice I and II, and at the nearby site of Pavlov I, both South Moravia region (Czech Republic), up to 27 000-year-old imprints of interlaced twisted strings have been preserved on fired clay fragments (Adovasio et al. 1996). The clay imprints show different types of twining. The authors identified cordage with knots, plaited basketry and woven textiles, »[...] and the fineness of some of the weaves suggest [sic] [...]« that they were »fully flexible cloth fabrics« (Adovasio et al. 2001, 58). Although some authors doubt this (Valoch 2007; cf. Soffer/Adovasio 2014), similar finds from the Russian Far East, dated to the boundary between the Pleistocene and Holocene, confirm the original interpretation (Hyland et al. 2002). Evidence of working with (plant) fibres stems from Ohalo II in Israel about 19 000 years ago (Nadel et al. 1994) and several sites in Europe and Russia (Soffer et al. 2000a). O. Soffer et al. (2000b) provide an overview of the depiction of dress elements of Gravettian female figurines. These examples all suggest that people at the time of the Aghitu needle had the necessary know-how to make rope and thread.

Potential materials for sewing thread include plant components, such as blades of grass and other natural fibres, and animal products, such as thinly cut strips of hide and prepared sinews. Following the contemporaneous evidence from the geographically close Dzudzuana Cave, we reconstruct thread made of dyed plant fibres. Both fibres and dye-producing plants are the desired materials and must be acquired and processed according to their characteristics and with the appropriate equipment (see, for example, Hurcombe 2014). The fibres need to be extracted, cleaned and aligned; liquids or pastes are made from the dye-producing plants. During the dying process, the fibres are infused by the dying substance: both form an inseparable compound material, which can then be spun, plied, and twisted in a multitude of ways (cf. Jørgensen et al. 2023).

## Assembling the garment

To achieve the desired result, the pieces of tanned hide must be tailored into a garment according to patterns and the dimensions of the anticipated wearer (Osborn 2014). Different techniques may then be used to join the pieces together. To pierce two or more thick layers of tanned hide or leather, it can be advantageous to use an awl – potentially in com-

bination with a punching board (Doyon et al. 2023) – as an awl is much stronger and more resilient than a fragile needle. Then, the parts can be seamed together with needle-and-thread (variant 1). If the pieces of hide are pierced only with an awl, without additionally using needle-and-thread (variant 2), smaller holes may result, as they are not widened by the proximal end of the needle, which is broader due to the eyelet. In this case, however, experimental archaeologists suggest that the ends of the thread must be stiff, as when using unsoftened sinew, for example (R. Walter, pers. comm.). In a third variant, an eyed needle is used with thin and flexible thread without the necessity of piercing with an awl, as reconstructed in the cognigram shown in Fig. 10a. The technique of sewing with eyed needle-and-thread can vary significantly depending on purpose or tradition (Siebrecht et al. 2023; Nomokonova et al. 2024).

Needle-and-thread represents a complementary set of separate yet interdependent tools (comparable to bow-and-arrow, see Lombard/Haidle 2012), with the needle acting as an enhancing element, while the thread serves as a consumable element. Both elements are exchangeable and can vary in their properties and capacities. The application of the consumable element, the thread, is actively augmented by the enhancing element, the needle, which is handled and controlled by the user. The diameter of the eyelet of the needle – and thus the width of its proximal end and the width of the holes produced – corresponds to the thread size and quality; needle-and-thread have to be chosen together to suit the purpose. A specific characteristic of the needle-and-thread complementary set is the transfer of the consumable part, the thread, to the tailored pieces, thus creating a composite artefact with new emerging qualities beyond those of its three basic elements.

### Decoration

Another composite, which can be realised with the help of the needle-and-thread tool set, is the decoration of the garment with appliqués. At Aghitu-3, people used shells of freshwater snails, which they likely cleaned of animal tissue and adhering dirt, and perforated using punches or drills. In a process of complementary tool use similar to the assembling of garments, several components – clothing, shells, thread, plus a meaningful pattern – could be combined to create a composite with new emerging qualities beyond those of its basic elements (Fig. 10b).

## Why would a needle be advantageous?

Sewing experiments show that neither eyed bone needles nor awls are required to manufacture even complex clothing (D. Olthof, pers. comm.; Klek 2012; see IJsveld/Olthof in this volume). The experimental archaeologist R. Walter (pers. comm.) reports that a sinew thread with a dry, stiff end can easily be pushed through holes prefabricated in hides with an awl. However, needles may be advantageous in using different sewing materials or to create specific qualities along the seams. Even if a tailored piece is perforated with an awl, flexible and thin plant-based thread, for instance, is difficult to insert. Here, the advantage of using an eyed needle lies in its ability to draw the thread more easily through the holes. If eyed needles are not used, the thread must be pushed through the holes using the awl[1]. Thus, eyed needles can help to draw thin and flexible thread through prefabricated holes, to avoid an additional piercing step in thin hides, or to make stitches that do not perforate all of the layers of the pieces to be joined. Inuit seamstresses do not puncture the layers completely but push »the needle within the internal layers of the hide being sewn« (Siebrecht et al. 2023, 84). By using only eyed needles, they avoid holes in the outer layer of the garment, thus keeping the seams watertight and windproof.

The climate of the Late Pleistocene (130 000–12 000 years ago) was marked by large fluctuations in temperature and precipitation, with continental and alpine glaciers repeatedly advancing and retreating. Life without clothing would be difficult to imagine in large parts of continental Asia, especially during peak glacial intervals. In general, this also holds true at northern latitudes, at high elevations, and during the winter. Certainly, some kind of garment was required for protection against the environment[2].

Simple types of open clothing like a cape require an animal skin – which, however, has to be treated in an elaborate process to make it durable and comfortable (see above) – and the means to pierce it, for example, by using a large, robust bone awl. Yet simple clothing does not insulate its wearer as well as tailored and multi-layered clothing. Although making such garments does not imperatively require delicate tools such as eyed needles, these would have enabled the use of advanced techniques to create seams as well as affix ornaments to clothing, as the shell beads from Aghitu-3 suggest (Fig. 8). Clearly, advanced sewing work was of critical importance for human expansion above 50° of latitude, and survival in the Arctic or under Eurasian glacial conditions, just as it was highly valued in historical Siberia for the manufacture of dwellings, bed sets, storage bags, clothing, and footwear (Osborn 2014; Nomokonova et al. 2024).

## Discussion and conclusion

Gilligan's excellent research[3] explores the development of clothing. He unfolds various facets, such as the genetic divergence of human body lice and head lice as an indicator of clothing as separate habitat, the production of simple (draped) versus complex (layered and tailored) clothing, and aspects of thermodynamic regulation in cold climates.

1 In German, the word *pfriemeln* relates to *Pfriem* = awl, which implies an uncomfortable process.

2 Hosfield 2016; Osborn 2014; Gilligan 2007; Gilligan 2010; Gilligan 2017; Gilligan 2019; Gilligan et al. 2024.

3 Gilligan 2007; Gilligan 2010; Gilligan 2017; Gilligan 2019; Gilligan et al. 2024.

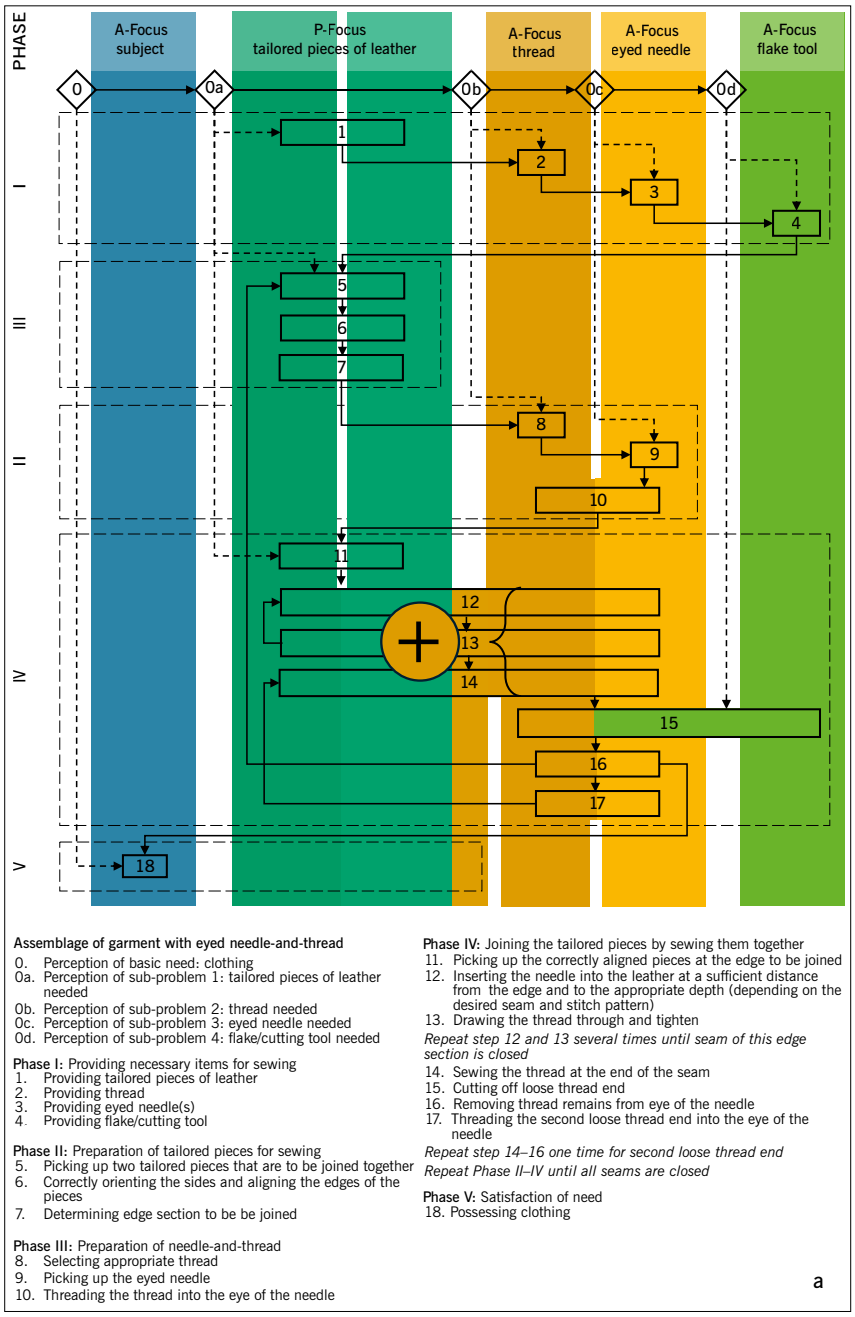

PHASE
A-Focus subject
P-Focus tailored pieces of leather
A-Focus thread
A-Focus eyed needle
A-Focus flake tool
I
II
III
IV
V
0
0a
0b
0c
0d
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Assemblage of garment with eyed needle-and-thread
0. Perception of basic need: clothing
0a. Perception of sub-problem 1: tailored pieces of leather needed
0b. Perception of sub-problem 2: thread needed
0c. Perception of sub-problem 3: eyed needle needed
0d. Perception of sub-problem 4: flake/cutting tool needed
Phase I: Providing necessary items for sewing
1. Providing tailored pieces of leather
2. Providing thread
3. Providing eyed needle(s)
4. Providing flake/cutting tool
Phase II: Preparation of tailored pieces for sewing
5. Picking up two tailored pieces that are to be joined together
6. Correctly orienting the sides and aligning the edges of the pieces
7. Determining edge section to be be joined
Phase III: Preparation of needle-and-thread
8. Selecting appropriate thread
9. Picking up the eyed needle
10. Threading the thread into the eye of the needle
Phase IV: Joining the tailored pieces by sewing them together
11. Picking up the correctly aligned pieces at the edge to be joined
12. Inserting the needle into the leather at a sufficient distance from the edge and to the appropriate depth (depending on the desired seam and stitch pattern)
13. Drawing the thread through and tighten
Repeat step 12 and 13 several times until seam of this edge section is closed
14. Sewing the thread at the end of the seam
15. Cutting off loose thread end
16. Removing thread remains from eye of the needle
17. Threading the second loose thread end into the eye of the needle
Repeat step 14–16 one time for second loose thread end
Repeat Phase II–IV until all seams are closed
Phase V: Satisfaction of need
18. Possessing clothing
a

**Fig. 10a–b** Cognigrams of (a) sewing a garment and (b) assembling a garment and shell ornaments with the complementary tool set of eyed needle-and-thread, showing the different attention foci (A = active: subject and tools, P = passive: objects), actions, and effects of tools on other foci. In the sewing process, the eyed needle and thread function as a complementary tool set (depicted as { in the graphic), joining together the tailored pieces resp. the garment and shell ornaments with the thread (depicted as + in the graphic) to form a new composite entity with new qualities[4].

***Abb. 10a–b*** *Kognigramme (a) des Nähens eines Kleidungsstücks und (b) der Zusammenfügung eines Kleidungsstücks und von Muschelornamenten mit dem komplementären Werkzeugset Nadel-und-Faden, das die verschiedenen Fokussierungen (A = aktiv: Subjekt und Werkzeuge, P = passiv: Objekte), Handlungen und Auswirkungen von Werkzeugen auf andere Schwerpunkte zeigt. Beim Nähvorgang fungieren die Nadel mit Öhr und der Faden als komplementäres Werkzeugset (in der Grafik als { dargestellt), das die zugeschnittenen Teile bzw. die Kleidungs- und Muschelornamente mit dem Faden zu einer neuen zusammengesetzten Einheit mit neuen Eigenschaften verbindet (in der Grafik als + dargestellt)*[5].

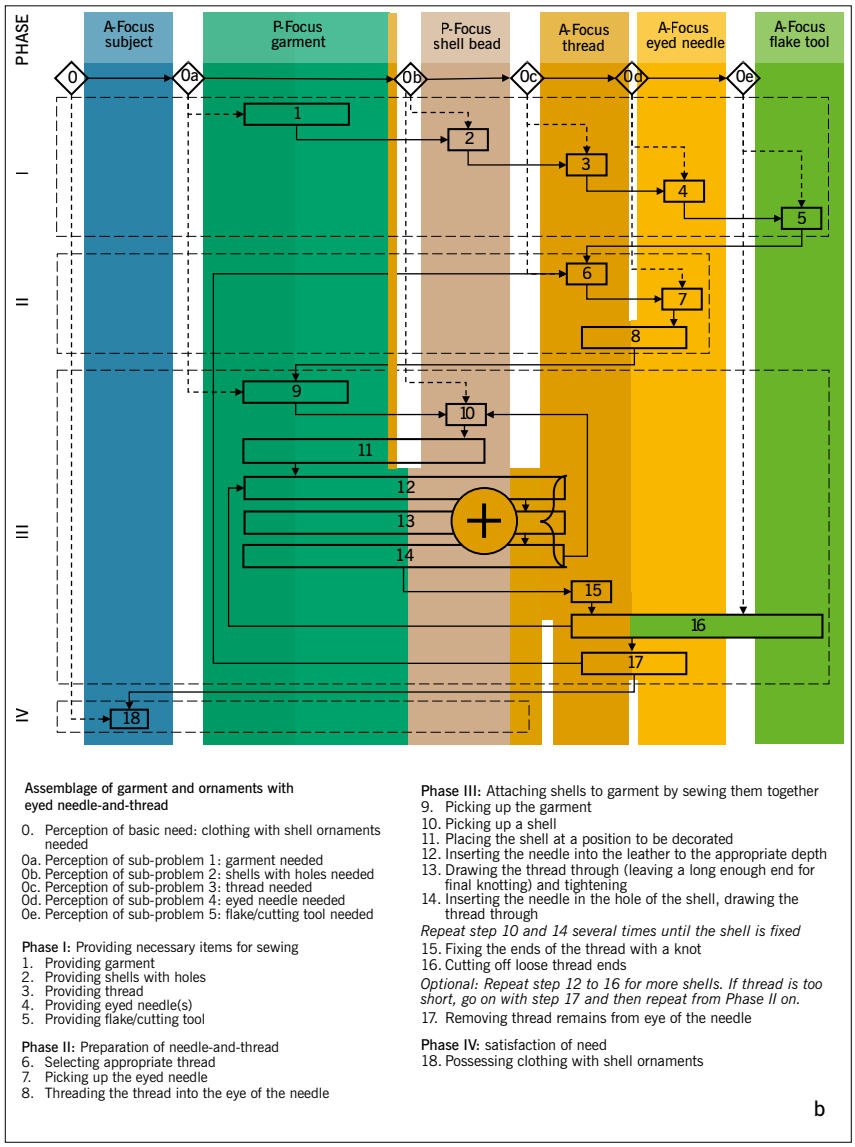
His comprehensive work on the subject also examines the toolkits required to fabricate clothing, especially stone and bone artefacts, while delving into the social and psychological aspects of clothing as well.

The case study of the eyed bone needle from Aghitu-3 highlights a single archaeological find, which must be read in its conception as well as its function as a complementary set of needle-and-thread, comparable to that of a bow-and-arrow set (cf. Lombard/Haidle 2012). Within the broader archaeological context, which includes stone tools, a bone awl, evidence of the use of plant fibre and dye, and possible decoration with shells, the needle additionally allows us to reconstruct a vast network of performances. These are associated with numerous raw materials, tools, products, and activities well beyond the narrow purview of sewing. Each of these elements was backed by knowledge of qualities and locations, seasonal or specific, and other limitations and legitimations; these include know-how of techniques and procedures and are based on acquired skills.

The basis for the development and maintenance of such an entangled corpus of performances must have been a community of practice (CoP) which incorporated several genera-

4 This simplified cognigram is not based on a specific example but represents foci and actions that are generally seen as part of the process; for details about cognigrams see Haidle 2023.

5 Dieses vereinfachte Kognigramm basiert nicht auf einem bestimmten Beispiel, sondern stellt Aufmerksamkeitsfoki und Aktionen dar, die allgemein als Teil des Prozesses angesehen werden; weitere Informationen zu Kognigrammen s. Haidle 2023.




**Assemblage of garment and ornaments with eyed needle-and-thread**

0. Perception of basic need: clothing with shell ornaments needed
0a. Perception of sub-problem 1: garment needed
0b. Perception of sub-problem 2: shells with holes needed
0c. Perception of sub-problem 3: thread needed
0d. Perception of sub-problem 4: eyed needle needed
0e. Perception of sub-problem 5: flake/cutting tool needed

**Phase I:** Providing necessary items for sewing
1. Providing garment
2. Providing shells with holes
3. Providing thread
4. Providing eyed needle(s)
5. Providing flake/cutting tool

**Phase II:** Preparation of needle-and-thread
6. Selecting appropriate thread
7. Picking up the eyed needle
8. Threading the thread into the eye of the needle

**Phase III:** Attaching shells to garment by sewing them together
9. Picking up the garment
10. Picking up a shell
11. Placing the shell at a position to be decorated
12. Inserting the needle into the leather to the appropriate depth
13. Drawing the thread through (leaving a long enough end for final knotting) and tightening
14. Inserting the needle in the hole of the shell, drawing the thread through

*Repeat step 10 and 14 several times until the shell is fixed*

15. Fixing the ends of the thread with a knot
16. Cutting off loose thread ends

*Optional: Repeat step 12 to 16 for more shells. If thread is too short, go on with step 17 and then repeat from Phase II on.*

17. Removing thread remains from eye of the needle

**Phase IV:** satisfaction of need
18. Possessing clothing with shell ornaments

b

tions and expanded across the boundaries of the daily core group. Although the central process of sewing and manufacturing tools for this activity is generally associated with women (Osborn 2014; Siebrecht et al. 2023; Nomokonova et al. 2024), we do not know who was responsible in the Eurasian Upper Palaeolithic (cf. Owen 2005). Regarding the broader context, it is likely that both sexes were involved in the manufacture of clothing.

Similar to recent examples of situated learning documented by J. Lave and E. Wenger (1991), the CoP likely encompassed all ages, from very young children to older people. According to their affiliation with age and sex categories, as well as individual capacities, the CoP members were involved in the performances with different motivations, targets, contributions, and legitimations. Corresponding to their distinct possibilities and positions within the group, the CoP members exchanged material, conceptual, and social resources such as assistance, work, care, knowledge, know-how, skills, role models, equipment, and orchestration. Through continuous individual development and social transmission, the network of performances could be maintained and adjusted to meet new environmental or cultural requirements.

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## Source of figures

1 C. Sommer, ROCEEH, using data from ROAD (Kandel et al. 2023)
2 A. Kandel, ROCEEH
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5 E. Ghasidian, University of Tübingen
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# Flachsverarbeitung – Rottegruben im archäologischen Befund. Fallbeispiel Großgrimma, Burgenlandkreis

Susanne Friederich, Andrea Moser und Jonathan Schulz

**Summary**

Flax processing – retting pits in the archaeological record. Case study: Großgrimma, Burgenlandkreis District

*Flax is one of the earliest cultivated plants. Since the Neolithic period, both flax seeds and flax fibres have been of considerable importance, although the two different raw materials (food, textiles) are seldom reflected in the archaeological record due to preservation conditions. In particular, evidence for the very laborious process of fibre extraction is likely to have often gone unrecognised until now, even though the treatment of the flax stems produces a characteristic picture: clusters of pits, some of which are intersected by ditch-like structures. These ensured that the wastewater drained quickly from the shallow, irregular retting pits. Such processing pits have survived into modern times. In the Domsen opencast mine in the Burgenlandkreis District, anthropogenic terrain modelling has saved organic finds. This will make it possible in the future to detect prehistoric flax retting even without preserved plant remains.*

**Keywords** Flax processing, retting pits, fibre extraction, cluster of pits

**Zusammenfassung**

*Lein ist eine der frühesten Kulturpflanzen. Seit dem Neolithikum kommen sowohl Leinsamen als auch Flachsfasern eine erhebliche Bedeutung zu, wenngleich sich die beiden unterschiedlichen Rohstoffe (Nahrung, Textil) aufgrund ihrer Erhaltungsbedingungen im archäologischen Befund kaum abbilden. Vor allem die sehr aufwendige Fasergewinnung dürfte bislang oftmals unerkannt geblieben sein, obgleich die Zersetzung der Flachsstängel ein charakteristisches Bild erzeugt: Grubencluster, teilweise durchzogen von grabenähnlichen Strukturen. Diese garantierten den schnellen Abfluss des Faulwassers aus den flachen, unregelmäßigen Rottegruben. Bis in die Neuzeit sind solche Wirtschaftsgruben überliefert. Im Tagebau Domsen, Burgenlandkreis, bewahrten anthropogene Geländemodellierungen organische Funde. Damit wird es zukünftig gelingen, vorgeschichtliche Flachsrösten auch ohne erhalten gebliebene Pflanzenreste zu detektieren.*

**Schlagwörter** Flachsverarbeitung, Rottegruben, Fasergewinnung, Grubencluster

## Einleitung

Lein zählt wie auch Einkorn, Emmer, Erbse und Linse zu den ersten bzw. wichtigsten Kulturpflanzen, die mit dem Beginn des Neolithikums aus dem Mittelmeerraum und dem Vorderen Orient nach Mitteleuropa gelangten (Karg 2011). Wenngleich sich der Lein im archäologischen Befund kaum niederschlägt, wird seiner faserreichen Variante, dem Flachs, schon früh eine hohe Bedeutung bei der Fertigung von Geweben zugekommen sein. Da Leinsamen sehr ölhaltig sind, verbrennen sie im Feuer sofort und verkohlen nicht. Entsprechend fehlen archäologische Nachweise der Leinverarbeitung beinahe gänzlich.

Archäologische Untersuchungen von Grubenbefunden in Großgrimma, Burgenlandkreis, aus dem 1. Jh. n. Chr. zeigen, wie unscheinbar und schwer zu interpretieren Rottegruben zur Leinverarbeitung sein können, wenn der Flachs selbst nicht erhalten ist. Die Rottegruben von Großgrimma machen dabei deutlich, dass der Flachsverarbeitung in vorgeschichtlicher Zeit wahrscheinlich eine deutlich größere Bedeutung zukam, als generell angenommen wird. Vor dem Hintergrund der Nachweise von Großgrimma und der Vielzahl archäologisch dokumentierter flacher Grubenbefunde unbekannter Funktion an vielen anderen Plätzen kann angenommen werden, dass die Textilherstellung aus Faserlein wohl geläufiger gewesen sein dürfte, als archäologisch nachgewiesen werden kann.

## Lein – Fasergewinnung

Die Verarbeitung von (Faser-)Lein gliedert sich in viele und aufwendige Arbeitsschritte; dennoch mangelt es für die vorgeschichtliche Zeit an direkten oder indirekten Nachweisen.

Typische, sich gegebenenfalls im archäologischen Befund niederschlagende Ackerfluren, beispielsweise Brachflächen im Siedlungsareal, sind nicht bekannt. Flachs erfordert nämlich nicht nur jährlich einen neuen Standort, sondern – obgleich magere Böden durchaus ausreichen – sogar eine

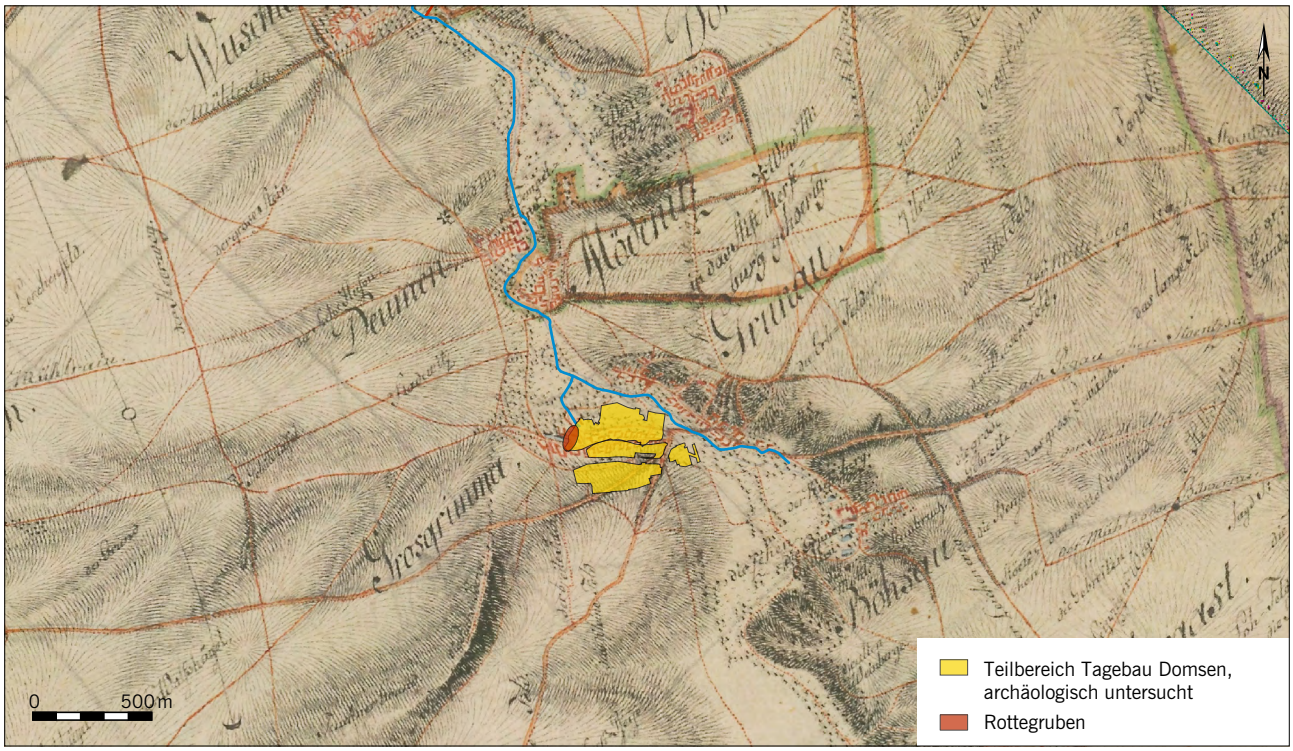


**Abb. 1** Die ehemalige Ortschaft Großgrimma, Burgenlandkreis, sowie die archäologische Fundstelle Großgrimma befinden sich südlich des ehemaligen Flusslaufes der Grunau bzw. östlich eines Zulaufrinnsals. Die Grunau und ihre Nebenflüsse sind im Zuge der Tagebauerschließung Domsen bereits in den späten 1930er- bzw. frühen 1940er-Jahre umgeleitet und ihre Bachbette mit 2–3 m Materialaufschüttung nivelliert worden.

***Fig. 1*** *The former village of Großgrimma, Burgenlandkreis District, and the archaeological site of Großgrimma are located to the south of the former course of the Grunau River and to the east of a tributary channel. The Grunau and its tributaries were already diverted in the late 1930s and early 1940s in the course of the Domsen opencast mine development and their stream beds were levelled with 2–3 m of fill material.*

mehrjährige Ruhephase des Bodens[1]. Erntesicheln kamen bei Faserlein nicht zum Einsatz. Die Pflanze wurde einige Monate nach der Frühjahrsaussaat[2] bündelweise mit ihren Wurzeln aus dem Boden gerauft[3]. Der sich anschließende Trocknungsprozess bleibt im archäologischen Befund ohne Niederschlag, selbst wenn nicht die Umgebungsluft, sondern Warmluft einer Herdstelle oder einer Darre ausgenutzt wurde. Bislang fanden sich in diesen Befunden keine Rückstände von Faserlein.

Wollte man für das Aufbrechen der Stängel den langwierigen Prozess der Tauröste vermeiden (Karg 2022a, 33) – die auf feuchter Erde oder moorigem Boden ausgelegten trockenen Stängel werden durch tägliche Temperaturschwankungen und Sonneneinwirkung zersetzt –, bietet die Wasserröste eine schnelle, wenngleich komplexe Variante[4]. In Gruben, die in wasserundurchlässigen Böden abgeteuft wurden, legte man getrocknete Flachsbündel geordnet ein und beschwerte diese mit Steinen[5], damit sie – ist das Wasser einmal eingeleitet – nicht aufschwammen[6]. Während des bakteriell verursachten Gärungsprozesses, auch als Fäulnis bezeichnet[7], der je nach Sonneneinstrahlung und damit je nach Wassertemperatur wenige Tage bis maximal vier Wochen andauert, darf das Wasser keinesfalls ausgetauscht oder verdünnt werden. Das Pektin der Zellwände zerfällt allmählich[8]. Weil die letzten Stunden über die Auflösung der Pflanze entscheiden, ist viel Erfahrung notwendig.

Nach nochmaligem Trocknen der jetzt stark zersetzten Stängel springt das die Faser umgebende Holz gut ab. Dadurch ist das Holzgewebe im Stängelinneren nicht mehr mit den peripher gelegenen Faserbündeln verknüpft und

1 Heute Anbau auf großen Flächen mit Düngezusatz. Ohne Düngemittel kann Flachs maximal zwei Jahre hintereinander an der gleichen Stelle angebaut werden, dann ist eine möglichst siebenjährige Pause notwendig (Schilperoord 2018, 16).

2 Erntereif, sobald die Stängel vergilben (Körber-Grohne 1987).

3 Die verschiedenen Arbeitsprozesse wurden schon früh beschrieben. Die ältesten Darstellungen sind aus dem 4. Jt. v. Chr. aus Ägypten bekannt. Welche Rolle Leinengewebe spielte, bezeugt die von Ovid gewählte Bezeichnung der ägyptischen Göttin Isis als Leinengöttin. Der Reichtum der Augsburger Fuggerdynastie beruhte auf Handel mit Leinen. Im 19. Jh. war Leinenanbau in größerem Maßstab nur noch auf der niederschlagsreichen Schwäbischen Alb rentabel. Im frühen 20. Jh. sollte mit einer Wiederbelebung des Faserleinanbaus eine Unabhängigkeit von der Baumwolle erzielt werden. Die sprichwörtliche Redewendung »ins Blaue fahren« geht auf die blau blühenden Felder zurück (Karg 2022; Karg 2022a). Mit dem 1957 in Tschechien produzierten Film »Wie der Maulwurf zu seiner Hose kam« wurde ein schulisches Lernmittel zum jahrtausendelang praktizierten Verarbeitungsprozess von Faserlein bereitgestellt.

4 Flachsrotten sind sowohl aus dem frühen Ägypten als auch dem Römischen Reich und von den Wikingern bekannt (Andresen/Karg 2011).

5 Ggf. wurde zwischen die Flachsbündel und die Beschwerungen Stroh eingebracht (vgl. Körber-Grohne 1987, 366 ff.).

6 Bereits nach wenigen Tagen beginnt die Gärung. Aufsteigende Gase würden die Pflanzen nach oben treiben. Kurze Zeit später fällt der Flachs in sich zusammen (Körber-Grohne 1987, 366 ff.).

7 Die anaeroben Bedingungen wirken Schimmelpilzen entgegen.

8 Es vergären die aus Pektin bestehenden Wandteile (Mittellamelle und angrenzende Wandteile) im Rindengewebe (Kull 2019, 94–95; 206–208).

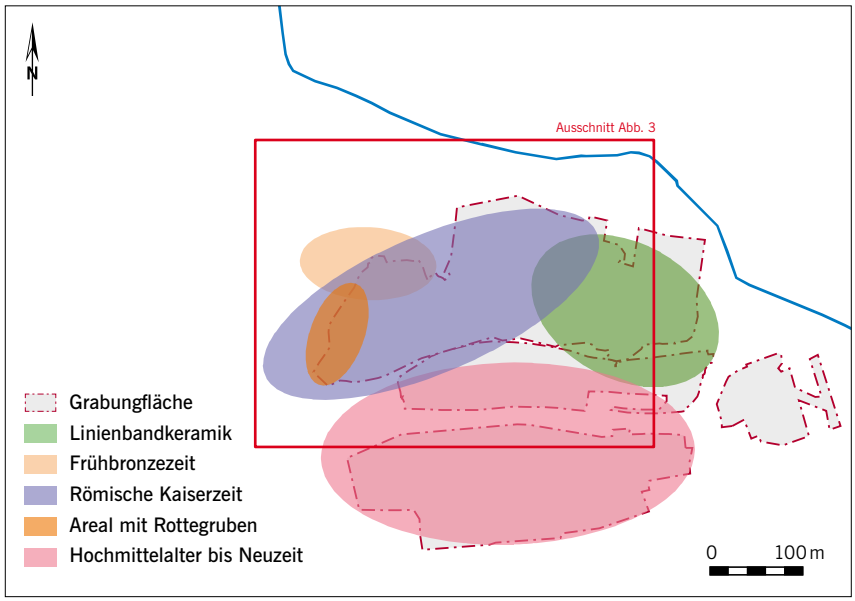


**Abb. 2** Großgrimma. Die archäologische Fundstelle wird im Zuge der Kantenbegradigung des Tagebaus Domsen teilweise tangiert. Große Teile sind bereits facharchäologisch aufgedeckt und dokumentiert. Die Siedlungsspuren reichen von der Linienbandkeramik über die frühe Bronzezeit und die Römische Kaiserzeit bis ins Hochmittelalter bzw. die Frühe Neuzeit. Um 1200 n. Chr. etablierte sich im während der Römischen Kaiserzeit genutzten Siedlungsbereich ein Wirtschaftsareal für die Gewinnung von Flachsfasern (Ausschnitt s. Abb. 3).

***Fig. 2*** *Großgrimma. The archaeological site has been partially impacted by the edge straightening of the Domsen opencast mine. Large parts have already been uncovered and documented by specialist archaeologists. The traces of settlement range from the Linear Pottery Culture through the Early Bronze Age and the Roman Imperial Period to the High Middle Ages and the early modern era. Around 1200 AD, a production site for the extraction of flax fibre was established in the settlement area used during the Roman Imperial period (detailed illustration, see Fig. 3).*

lässt sich leichter trennen (Körber-Grohne 1987, 266 ff.). Solche sog. Leinenschäben sind aus jungsteinzeitlichen Feuchtbodensiedlungen bekannt[9]. Die dortigen Erhaltungsbedingungen für organische Materialien konservierten zudem auch kammartige Werkzeuge, mit denen die noch ungeordneten Fasern parallel ausgerichtet wurden. Angespitzte Rippenknochen, meist von Rindern, wurden zusammengebunden bzw. mit Birkenteer zu Hechelkämmen verklebt[10]; vergleichbare Werkzeuge sind aus dem mitteldeutschen Raum bislang nicht bekannt[11].

Die nun vorliegenden Fasern des Leins lassen sich mit einer Handspindel sogar einfacher als jene von Lindenbast oder Nessel verarbeiten. Feuchte Leinfaserprodukte sind zudem widerstandsfähiger (Karg 2022a) und somit für den Einsatz in der Fischerei besonders geeignet. Zudem nimmt die Leinenfaser sehr schnell Wasser auf, sodass die Netze nicht aufschwimmen, sondern im Wasser stehen (Technische Textilien 2022). Einzelne Schnursegmente, Bastgefäße oder bruchstückhafte Textilien sind für den mitteldeutschen Raum seit dem Neolithikum vereinzelt überliefert[12].

Die Wasserröste sollte sich im archäologischen Bild erkennen lassen. Bei bislang als undefinierte Grubencluster angesprochenen Befundensembles könnte es sich, sofern sie im Niederungsbereich liegen, möglicherweise um Wirtschaftsareale der Flachsproduktion handeln. Selbst bei gelegentlich nicht ausgeräumten Rottegruben dürften sich jedoch die Flachsbündel, insbesondere in gut durchlüfteten Mineralböden, längst bis zur Unkenntlichkeit zersetzt haben. Da die Beschwerungssteine häufig auch im oberen Befundbereich oder den auslaufenden Rändern der Gruben liegen, dürften sie infolge langjähriger landwirtschaftlicher Nutzung der Röstareale nicht mehr vorhanden sein. Zudem fallen locker verteilte Steine im Grabungsalltag nicht als anthropogen eingebrachtes Fundgut auf. Anstelle von Steinen könnten auch schon längst vergangene Holzscheite oder andere Materialien die Pflanzenstängel unter Wasser gedrückt haben.

## Die Flachsrotten von Großgrimma

Als Musterfall gilt die 2023 erstmals erschlossene Fundstelle Großgrimma, Burgenlandkreis, im Tagebaufeld Domsen[13]. Landschaftsprägend ist der einst recht breite und tief ins Gelände eingeschnittene Fluss Grunau[14] (Abb. 1). Entlang des Gewässers siedelten bereits die ersten Ackerbauern (linienbandkeramische Kultur). Für die Frühbronzezeit und die Römische Kaiserzeit ist eine erneute Nutzung der Flächen nachgewiesen (Abb. 2). Ein innerhalb der Aue gelegener Talkessel wurde für die Wasserrotte resp. Flachsverarbeitung genutzt. Der lehmhaltige Boden garantierte eine gute Abdichtung und eine Steigung von ungefähr 6 %[15] ermöglichte über das hangflankierende Zubringerrinnsal der Grunau das zügige Ableiten der mit Bakterien verseuchten Faulbrühe in das nur 175–250 m entfernte Fließgewässer. Bis

9 Bspw. Alleshausen-Grundwiesen, Lkr. Biberach (Baden-Württemberg).

10 Deschler-Erb u.a. 2002, 294 Abb. 404. Ein vergleichbares 10 200 Jahre altes Gerät ist aus Israel, Murabha-Höhle, bekannt (Shamir 2020, 27).

11 Verschnürungen erhalten sich in den mitteldeutschen Mineralböden nicht. Eine systematische Durchsicht der Tierknochenkomplexe, insbesondere unter dem Aspekt angespitzter Rippenknochen, ist in Vorbereitung. Lange Zeit wurden die artifiziell rundgekerbten Schulterblätter von Rindern als Flachshechel gedeutet (Lehmann 1931; Lehmann 1935). Die vor allem aus der mittelneolithischen Zeit, insbesondere der Bernburger Kultur (vgl. Nuglisch 1964, 801) bekannten Geräte werden heute in Zusammenhang mit der Lederverarbeitung gebracht (Feustel 1980; Luik 2013).

12 Latdorf, Salzlandkreis, Unterteutschenthal, Saalekreis, oder Ditfurt, Lkr. Harz (Hertel/Grömer 2019).

13 Akt.-Nr. 9917, Teilfläche E. Grabungsleitung A. Moser und J. Schulz. Die Geländearbeiten fanden von August bis September 2023 statt. Eine Rottegrube (Bef. 3504) wurde als Block geborgen und von Januar bis September 2024 freigelegt; die Konservierung dauert derzeit noch an.

14 Heute gilt die Grunau als kleiner Bach, historische Quellen zeigen vielmehr einen Fluss und eine sumpfige Niederung an.

15 Die Grunau liegt bei ca. 139 m HN. Im unteren Auenabschnitt steigt das Gelände zunächst sanft an; Steigung ca. 3 %. Oberhalb der tiefen Auenlage ist ein Höhenunterschied von fast 6 % zu verzeichnen (141,47–148,79 m HN).

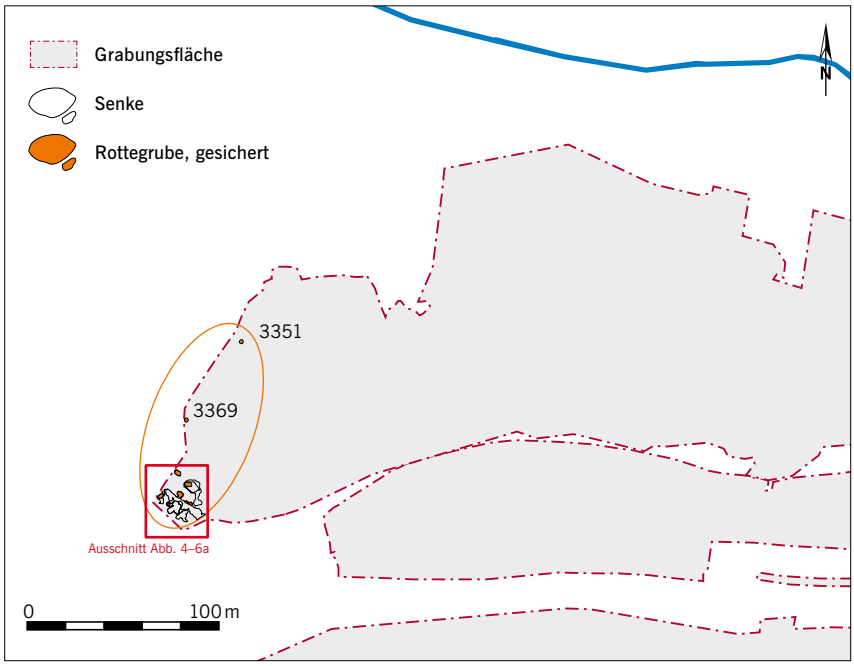


**Abb. 3** Großgrimma, Wirtschaftsareal Faserleingewinnung (Ausschnitt Abb. 2). Das für die Gewinnung von Faserlein genutzte Areal ist teilweise erfasst: auf 20 × 80 m.

***Fig. 3*** *Großgrimma, industrial area for extracting flax fibre (detailed section Fig. 2). The area used for processing flax fibre is partially recorded: 20 × 80 m.*

vor 80 Jahren überdeckten natürliche Sedimentlagen zzgl. Oberboden die Befunde mit 90 cm Material. Die Wasserhaltung des 1941 eröffneten Tagebaus erforderte einen zusätzlichen, mehr als 2 m mächtigen Bodenauftrag. Dadurch fiel die Aue selbst in den Hitzesommern Ende der 1940er- und Anfang der 1950er-Jahre sowie in dem zurückliegenden, von viel Sonne und wenig Niederschlägen geprägten letzten Jahrzehnt niemals trocken.

| Befundnr. | Länge (cm) | Breite (cm) | Tiefe (cm) |
|---|---|---|---|
| 3351 | 191 | 177 | 140 |
| 3369 | 210 | 188 | 16 |
| 3444 | 400 | 260 | 12 |
| 3494 | 155 | 135 | 16 |
| 3496 | 290 | 220 | 16 |
| 3504 | 360 | 235 | 80 |
| 3505 | 175 | 175 | 7 |

**Tab. 1** Großgrimma, Rottegruben. Übersicht zur Größe. Die Tiefen variieren. Bei den Ausmaßen lassen sich die Rösten häufig nicht deutlich von den Senken trennen, z.B. ist Bef. 3444 im Zentrum deutlich kleiner.

***Tab. 1*** *Großgrimma, retting pits. Overview of dimensions. Depths vary. In terms of overall dimensions, it is often difficult to distinguish between the pits and the depressions; for example, feature 3444 in the centre is significantly smaller.*

Am südlichen Hang über der Grunau streuen die als Flachsrösten anzusprechenden Befunde[16] über eine Strecke von 125 m (Abb. 3). Die Röstegruben sind ungefähr 5 m² groß (ca. 200 × 250 cm) und meist nicht tief; die Erhaltungstiefe einmalig genutzter Rotten beläuft sich auf 10–20 cm. Da die Wirtschaftsgruben in natürlichen Senken abgeteuft worden sein dürften, fallen im archäologischen Planum zunächst ehemalige Senken als große amorphe Befunde auf (Abb. 4), die sich erst nach 5–20 cm Tiefe in Einzelbefunde – hier Rottegruben (Abb. 5) und Entwässerungskanal (Abb. 6) – auftrennen. Zwei Befunde mit Tiefen von 80 cm und mehr vermitteln die ursprüngliche Eingrabung (Bef. 3351 und 3504; Tab. 1). Zwei Rottegruben (Bef. 3351 und 3369), jeweils mit erhaltenen Flachsbündeln, befinden sich außerhalb eines eng bewirtschafteten Areals von weit mehr als 100 m² Fläche[17] (vgl. Abb. 3). Hier lassen sich mindestens sieben Rottegruben (Bef. 3444, [3468], 3494, 3496, 3504, 3505 und [3464/3506]) innerhalb eines Grubenclusters bzw. entlang einer Fließstruktur ausmachen (vgl. Abb. 6).

Wasserzu- und -abflüsse sind für Wasserrotten wichtig. Auch wenn das Umleiten von natürlichen Wasserläufen in Gruben eine Erleichterung darstellt[18], dürfte die Arbeitsersparnis freilich weniger groß gewesen sein als das Ableiten des Faulwassers nach Abschluss der Flachsröste[19]. Während bei Einleitung von Frischwasser die natürlichen oder künstlich geschaffenen Wasserläufe oberhalb der Rottegruben liegen, verlaufen Abwassergräben weiter hangabwärts. So lässt es sich auch für Großgrimma beobachten. Die über 25 m frei-

16 Die Geländearbeiten sind noch nicht abgeschlossen. In den Randbereichen des aktuell für die Stilllegung vorbereiteten Tagebaus sind in den kommenden Monaten abschließende Sanierungsarbeiten notwendig. Oberhalb des archäologischen Horizontes verlaufen für den Tagebau angelegte Wirtschaftsstraßen, aber auch Ausläufer der bis in die 1990er-Jahre bewohnten Ortschaft Großgrimma. Der archäologischen Grabung vorgeschaltet finden Tiefenenttrümmerungen der Bebauung statt.

17 Es ist davon auszugehen, dass das Wirtschaftsareal erheblich größer ist, jedoch außerhalb der aktuellen Untersuchungsfläche liegt. Aus Parsau, Lkr. Gifhorn (Niedersachsen), sind zahlreiche bis ins 20. Jh. genutzte, bis zu 1,5 ha große Flachsrottenfelder bekannt geworden – mit bis zu 60 und in Ausnahmen über 100 Wasserröstgruben (Eichfeld u. a. 2024).

18 Vgl. hierzu Sedrun, Schweiz: Einleitung eines Bergbachs in parallel zum Wasserlauf angelegten Gruben (Karg 2022, 32).

19 Das Faulwasser muss nach Ende der Wasserrotte schnellstmöglich abgeleitet werden. Mensch und Tier können infolge des hohen Gehaltes an vielerlei Mikroorganismen Schaden nehmen. Selbst bei zu geringer Verdünnung bzw. Einleitung in Gewässer mit geringer Strömung verendet der Fischbestand.

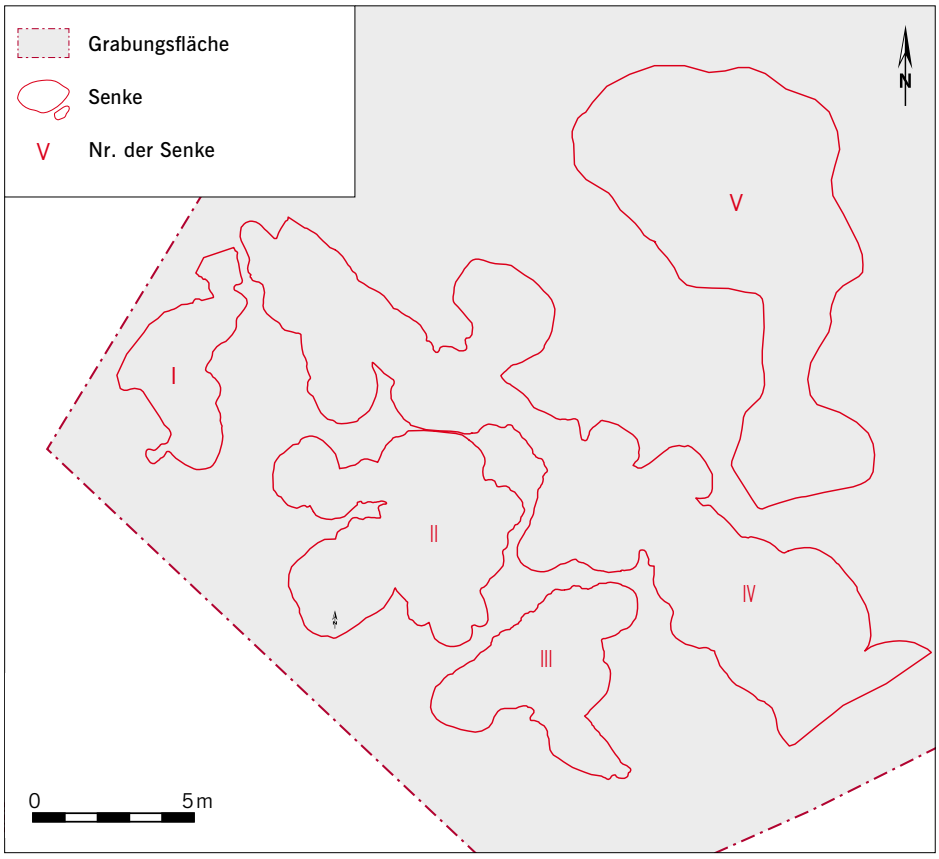


**Abb. 4** Großgrimma, Wirtschaftsareal Faserleingewinnung, Kernzone (Ausschnitt Abb. 3). Im ersten archäologischen Planum unter dem Pflughorizont zeichnen sich fünf große Befunde ab. Sie spiegeln ehemalige Senken wider, die im Laufe der Zeit einsedimentiert wurden. Senke I: Bef. ohne Nummer (Rottegrube 3494); Senke II: Bef. 3497 (Rottegrube 3496); Senke III: Bef. 3502 (ohne erkennbare Rottegrube, jedoch Durchstich zu Senke IV; vgl. Abb. 6a); Senke IV: Bef. 3491, Bef. 3516–3519, 3521–3523 (Entwässerungsstruktur mit anliegenden Rottegruben); Senke V: Bef. 3445 (Rottegrube 3504).

***Fig. 4*** *Großgrimma, production area for extracting flax fibre, core zone (detailed section Fig. 3). Five large features can be seen in the first archaeological planum below the plough horizon. They reflect former hollows that have been filled in with sediment over time. Depression I: feature without number (retting pit 3494); depression II: feature 3497 (retting pit 3496); depression III: feature 3502 (without recognisable retting pit but cut through to depression IV; see Fig. 6a); depression IV: feature 3491, features 3516–3519, 3521–3523 (drainage structure with adjacent retting pits); depression V: feature 3445 (retting pit 3504).*

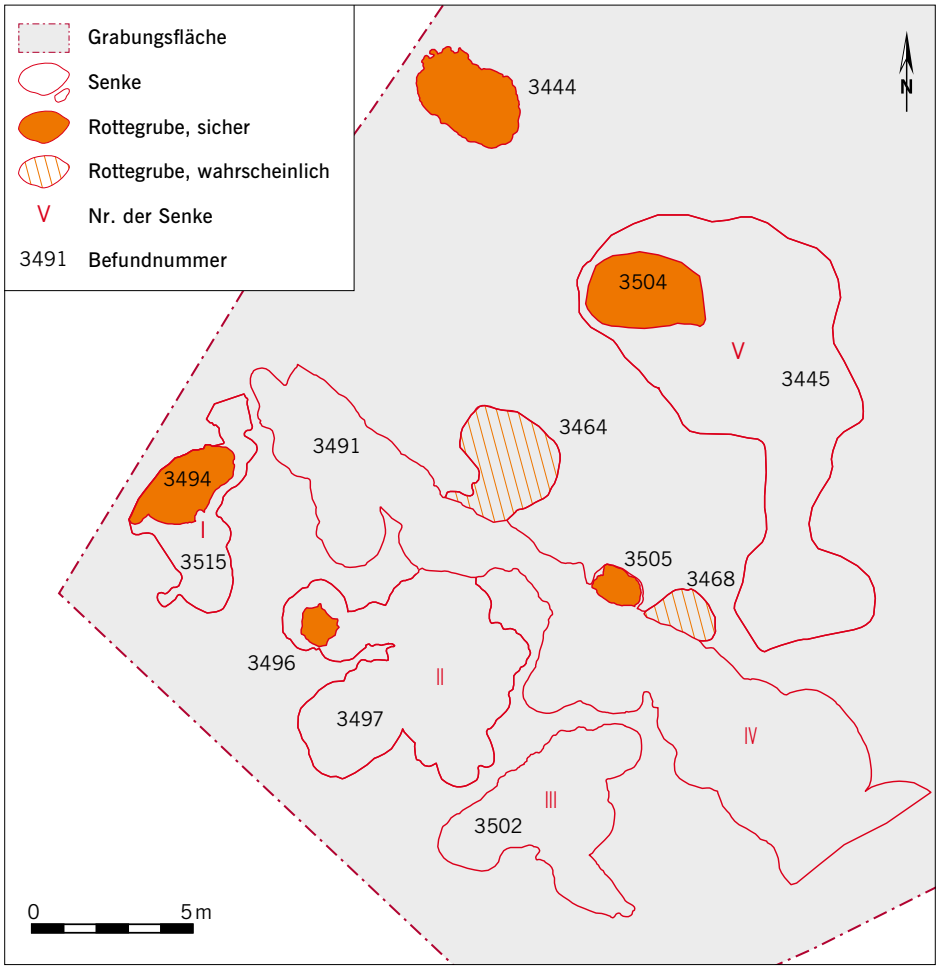


**Abb. 5** Großgrimma, Wirtschaftsareal Faserleingewinnung, Kernzone (Ausschnitt Abb. 3). In den Senken I, II und V befindet sich je eine Rottegrube (Bef. 3494, 3496, 3504). Eine weitere Grube (3505) liegt unmittelbar an der linearen Struktur IV. Die Befunde 3468 und 3464/3506 stellen möglicherweise auch Wasserrösten dar. Die Rottegrube Bef. 3444 liegt wie die beiden Rottegruben Bef. 3351 und Bef. 3369 (vgl. Abb. 3) ohne unmittelbare Verbindung zur Grabenstruktur der Kernzone.

***Fig. 5*** *Großgrimma, production area for extracting flax fibre, core zone (detailed section Fig. 3). In depressions I, II and V there is one retting pit each (features 3494, 3496, 3504). An additional pit (3505) is located directly next to linear structure IV. Features 3468 and 3464/3506 may also represent water retting. Like the two retting pits features 3351 and 3369 (cf. Fig. 3), the retting pit feature 3444 is not directly connected to the ditch structure of the core zone.*

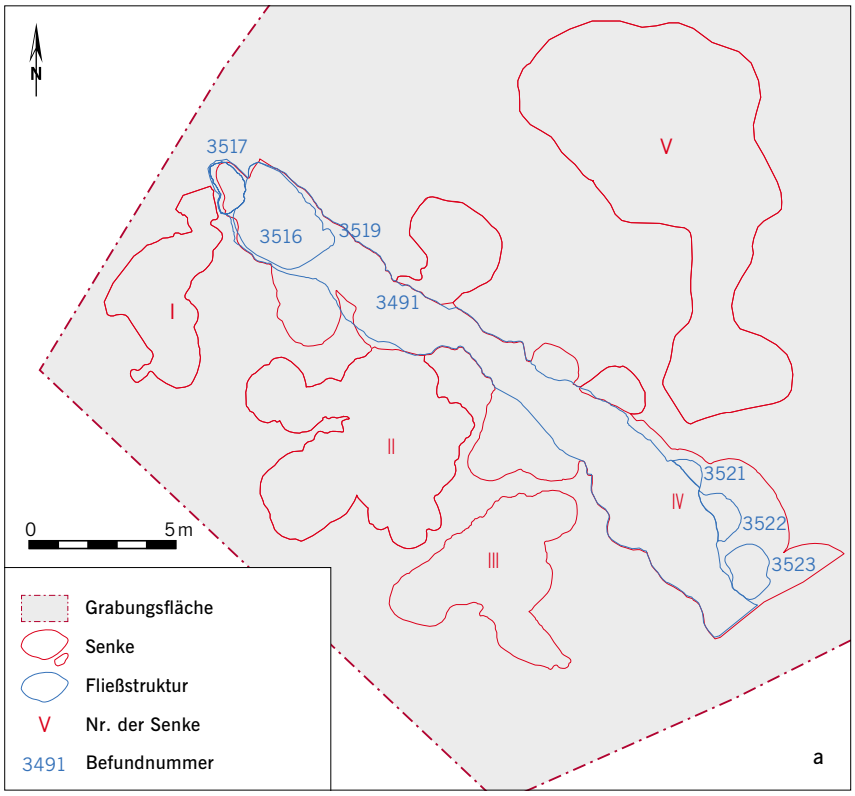

**Abb. 6a–b** a Großgrimma, Wirtschaftsareal Faserleingewinnung, Kernzone – Entwässerung. Die Senke IV stellt einen ehemals linear angelegten Graben dar. Es dürfte sich um einen künstlich geschaffenen Abflusskanal für das Faulwasser handeln. Er mündet vermutlich (außerhalb der Grabungsfläche) in einen Nord-Süd verlaufenden Zufluss der Grunau. Die Bef. 3517, 3516 und 3519 stellen möglicherweise nachträgliche Eingriffe in die grabenartige Struktur 3491 dar. Denn sobald der Wasserabfluss stockte, musste zügig der Schlamm von der Sohle entfernt oder für einen schnelleren Durchfluss die Sohle vertieft werden. Die Bef. 3521, 3522 und 3523 sind ebenso Elemente der grabenähnlichen Entwässerungsstruktur. b Blick von Nord nach Süd.

***Fig. 6a–b*** *Großgrimma, production area for extracting flax fibre, core zone – drainage. The depression IV represents a former linear ditch. It is probably an artificially created drainage channel for wastewater. It probably flows (outside the excavation area) into a north-south running tributary of the Grunau. Features 3517, 3516 and 3519 may represent subsequent interventions in the ditch-like structure 3491. As soon as the water flow stopped, the silt had to be quickly removed from the ditch floor, or the floor had to be deepened for a faster flow. Features 3521, 3522 and 3523 are also elements of the ditch-like drainage structure. b View from north to south.*

**Abb. 7** Rottegrube, Bef. 3504. Planum unmittelbar oberhalb Sohle: Deutlich zeichnen sich die eingebrachten Flachsbündel ab.

***Fig. 7*** *Retting pit, feature 3504. Planum immediately above the floor: the bundles of flax are clearly visible.*

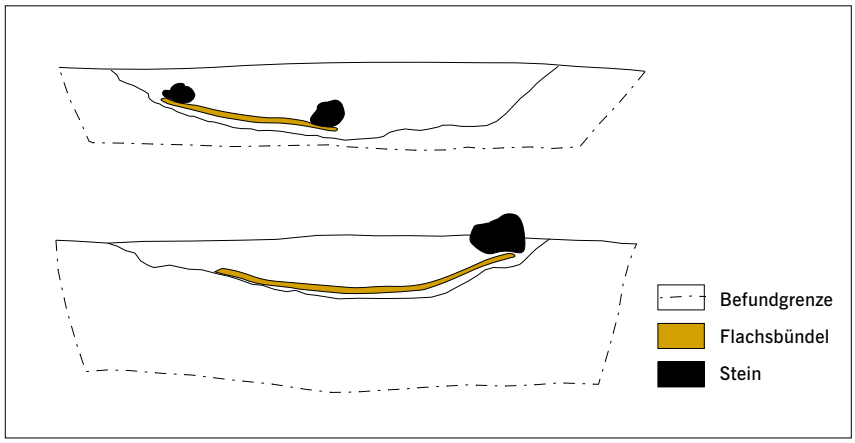


**Abb. 8** Rottegruben. Während der Fäulnisprozesse drückten Steine die Flachsbündel auf den Grubenboden. Grafische Darstellung der Bef. 3494 (oben) und 3496 (unten).

***Fig. 8*** *Retting pits. During the decomposition process, stones pressed the flax bundles down onto the pit floor. Graphic representation of features 3494 (above) and 3496 (below).*

| Flachsbündel Nr. | Länge (cm) |
|---|---|
| 1 | 51 |
| 3 | 65 |
| 7 | 44 |
| 9 | 47 |
| 12 | 48 |
| 14 | 35 |
| 15 | 51 |
| 16 | 43 |
| 17 | 40 |
| 23 | 53 |
| 25 | 51 |
| 28 | 50 |
| 30 | 41 |
| 33 | 41 |
| 34 | 50 |
| 36 | 52 |
| 40 | 41 |
| 41 | 49 |
| 42 | 63 |
| 44 | 41 |

**Tab. 2** Rottegrube, Bef. 3504. Länge der gut erhaltenen Flachsbündel

***Tab. 2*** *Großgrimma, retting pit, feature 3504. Length of the well-preserved flax bundles.*

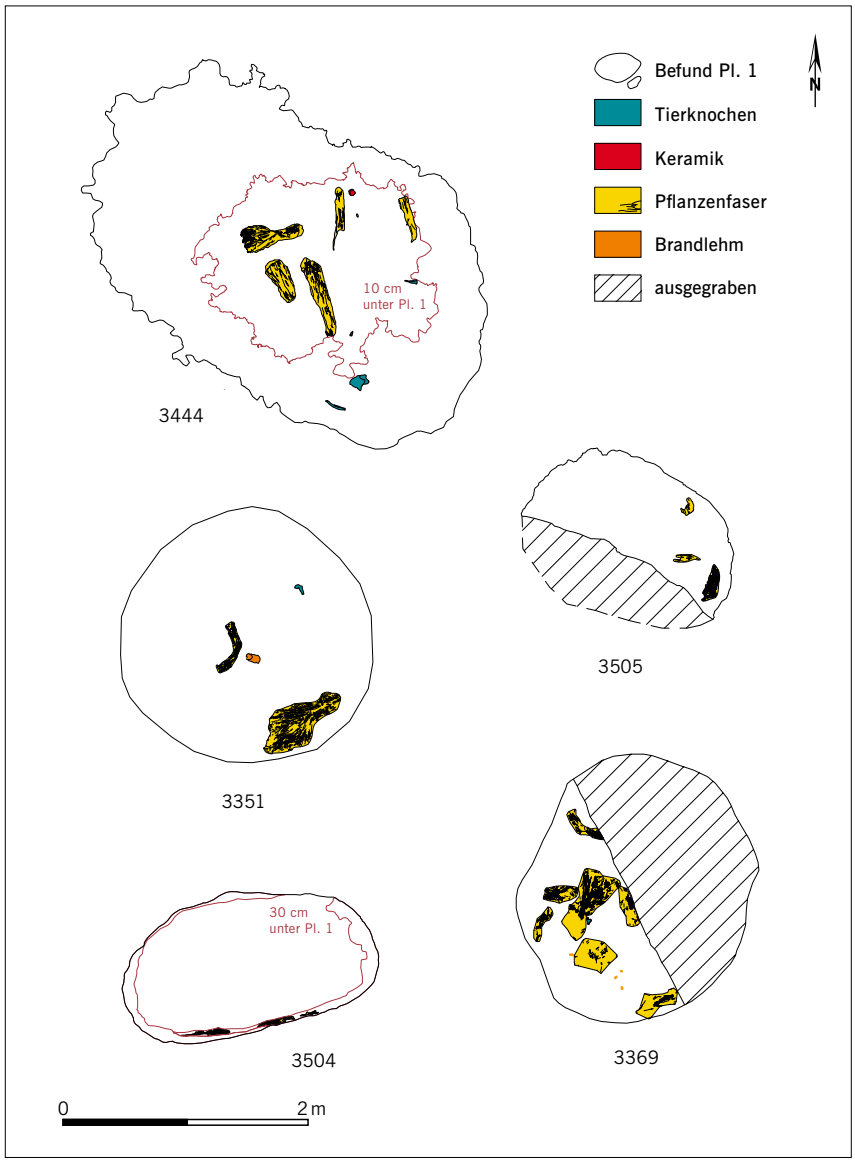


**Abb. 9** Rottegruben (Bef. 3351, 3369, 3444, 3505; zu 3504 vgl. Abb. 10–14). Mit der Wurzel aus dem Boden gerissene und zusammengeraufte Bündel des Faserleins wurden zunächst getrocknet. Der die Fasern umschließende, durch Pektin gebundene Bast kann durch Fäulnisprozesse gelöst werden. Nur in Ausnahmefällen verbleiben Flachsbündel in den Gruben – und bleiben im immer feuchten Milieu bis heute erhalten. Nicht umgezeichnet ist Bef. 9496.

***Fig. 9*** *Retting pits (features 3351, 3369, 3444, 3505; for 3504 see Fig. 10–14). The bundles of fibre flax were uprooted and raked together before being dried. The bast, which surrounds the fibres and is bound to them by pectin, can be detached by decomposition processes. Only in exceptional cases do bundles of flax remain in the pits – preserved in the moist environment up to today. Feature 9496 has not been redrawn.*

| Material | Maße (cm) | Gewicht (g) | Fd.-Nr. |
|---|---|---|---|
| Quarz | 6,2×4,2×3,6 | 161,5 | 201a |
| Quarz | 4,4×2,8×2,3 | 50,2 | 202a |
| Silex | 3,3×2,4×2,0 | 22,8 | 203a |
| 1 Stein *in situ* Planum 4 | 8,2×6,0×4,9 | kein Gewicht, da *in situ* | |

**Tab. 3** Großgrimma, Rottegrube, Bef. 3504. Maße und Gewicht der zum Beschweren der Flachsbündel genutzten Steine.

***Tab. 3*** *Großgrimma, retting pit, feature 3504. Dimensions and weight of the stones used to weigh down the flax bundles.*

gelegte lineare Struktur mit einer schwankenden Breite von 1–2 m zeigt eine Ausbau- bzw. Ausbesserungsmaßnahme (Bef. 3491 mit Bef. 3516, 3517, 3519) an. Ob ihre Aufnahmekapazität zu gering war oder sich das Wirtschaftsareal ausweitete bzw. über längere Zeit als zunächst angenommen genutzt wurde, kann aufgrund des kleinen Untersuchungsausschnittes nicht abschließend entschieden werden.

Alle sieben Rottegruben – erkennbar an erhaltenen Flachsbündeln (Tab. 1 und Abb. 7) oder charakteristischen, für die Beschwerung genutzten Steinen (Abb. 8 und 38) unmittelbar oberhalb einer auf organische Reste zurückzuführenden Bänderung sind wannenförmig, gelegentlich muldenförmig bei einer meist nur noch geringen Erhaltungstiefe der einst auf einer Fläche von 5 m² ausgehobenen Wasserbecken[20]. Die Beschwerungssteine sind meist nur faust- bis kindskopfgroß und wiegen zwischen weniger als 100 gr. und 500 gr. In einem Fall wurde auch der Teil eines Rinderschädels zum Hinunterdrücken der Flachsbündel verwendet (Bef. 3496, s. u. Abb. 43).

Auch natürliche Geländesenken lassen sich zu Flachsrösten umfunktionieren; die Großgrimmaer Rottebefunde dürften hingegen alle anthropogen sein.

In sechs Rottegruben haben sich Flachsbündel erhalten (Abb. 9): in Befund 3504 sogar fast 50 Stück mit einer Länge von 35–65 cm (Tab. 2). Diese sind fast alle in gleicher Ausrichtung in die Grube eingelegt worden und bedecken den gesamten Grubenboden (Abb. 10). Den zahlreichen, wenige Millimeter großen Samenkapseln[21] nach zu urteilen, streifte man die Leinsamen nicht, wie aus historischen Überlieferungen bekannt, vor oder nach dem ersten Trocknungsprozess ab (Abb. 11). Gegebenenfalls zeichnet sich auch ein unterschiedlicher Reifegrad bei den eingebrachten Pflanzenbündeln ab, zumal in einem Drittel des Befundes Samenkapseln fehlen (Abb. 12). Zwischen den Stängeln haben sich zudem Insekten verfangen, allerdings vor allem in den Randbereichen des Befundes (Abb. 13)[22].

Dass der Zersetzungsprozess in einigen Gruben nicht zu Ende geführt wurde und die Flachsbündel und die anorganischen Beschwerungselemente, also Steine (Tab. 3), in der Faulgrube verblieben, könnte sich auf Starkregenereignisse zurückführen lassen. Zunächst klärten bzw. verdünnten die großen Niederschlagsmengen das Faulwasser. Nachfolgende, mit Abfall durchsetzte Schlammströme (vgl. hierzu Einzelfunde in Abb. 14) dürften die Flachsbündel mit überdeckt und so bis heute konserviert haben. Doch das für die Flachsröste optimale Wirtschaftsareal – wasserundurchlässiger Untergrund, lokale Wärmezelle oberhalb des Talkessels, dem natürlichen Gefälle folgende Einleitung in ein Gewässer mit ausreichender Fließgeschwindigkeit – wurde nach dem skizzierten Unwetter nicht gänzlich aufgegeben (Bef. 3504; Abb. 15; Tab. 4). Die einstige Wirtschaftsgrube war sicherlich noch als Senke wahrnehmbar. Und ohne großen Aufwand, d. h. ohne nochmalige Ausräumung bis zur ursprünglichen Sohle wurde diese nochmals als Rottegrube verwendet. Wieder kam es zu Erdrutschen und die mit zu viel Regenwasser bzw. Matsch überdeckten Flachsbündel taugten nicht mehr zur Fasergewinnung. Möglicherweise fassen wir zwischen den beiden Verrottungsprozessen in Bef. 3504 nur eine kurze, von Starkregen geprägte Zeit. Denn am Hang von Großgrimma haben sich die aus dem lehmigen Untergrund um 1200 n. Chr. (s. u.) ausgehobenen Gruben trotz kontinuierlicher Witterungseinflüsse hervorragend erhalten. Das bezeugt eine Hunderte von Jahren später zum Ausgleich und vor allem zur Drainage einer wassergesättigten Geländedepression an einer einstigen Rottegrube vorgenommene Steinpflasterung (Bef. 3504 und Bef. 3445, Abb. 16).

Zu sechs Rottegruben liegen von unmittelbar oberhalb der Sohle bzw. Flachsbündel gelegenen Tierknochen Radiokarbondaten vor. Das Ergebnisbild zu acht bestimmten Tierknochen weist größtenteils in die Römische Kaiserzeit (Tab. 5). Die von einem Tierknochen aus Rottegrube 3494 genommene Ausreißer-Probe könnte leichtfertig als spätere Kontamination oder Fehldatierung unbeachtet bleiben. Zusammen mit dem aus Rottegrube 3504 knapp oberhalb der Flachsbündel geborgenen Schlitzhenkel (typologische Einordnung um 1200 n. Chr.) und den dort unmittelbar von den eingelegten Flachsbündeln – Stängel und Samenkapsel – gewonnenen Analyseergebnissen[23] wird folgendes Szenario skizziert:

Als um 1200 n. Chr. das oberhalb der Grunau gelegene Areal für die Wasserröste erschlossen wurde, zeichneten sich noch immer einige Gruben aus der vormaligen Besiedlung der Römischen Kaiserzeit als schwache Senken ab und waren als natürliche Geländedepressionen für die Anlage von Röstgruben prädestiniert. Bei der Umarbeitung der Mulden zu Wasserrösten stieß man gelegentlich auf fast 1000 Jahre altes Fundgut, wie z. B. jenen Rinderschädel[24],

20 Aus der vorrömischen Eisenzeit Jütlands (Dänemark) sind noch 1 m tief erhaltene Flachsrotten von 1–3 m Durchmesser überliefert (Karg 2003). Die neuzeitlichen Rottegruben aus Niedersachsen sind teilweise bei Durchmessern von bis zu 6 m teilweise noch 2 m tief erhalten (Eichfeld u. a. 2024).

21 Kleine Samenkapseln sind bei der faserreichen Variante des Leins zu erwarten (Karg 2022a).

22 Möglicherweise haben sich die Insekten an den oberflächennahen Pflanzen der langsam austrocknenden Flachsröste verfangen.

23 MAMS 77386 und MAMS 77387 (vgl. Tab. 5).

24 MAMS 77202 (vgl. Tab. 5).

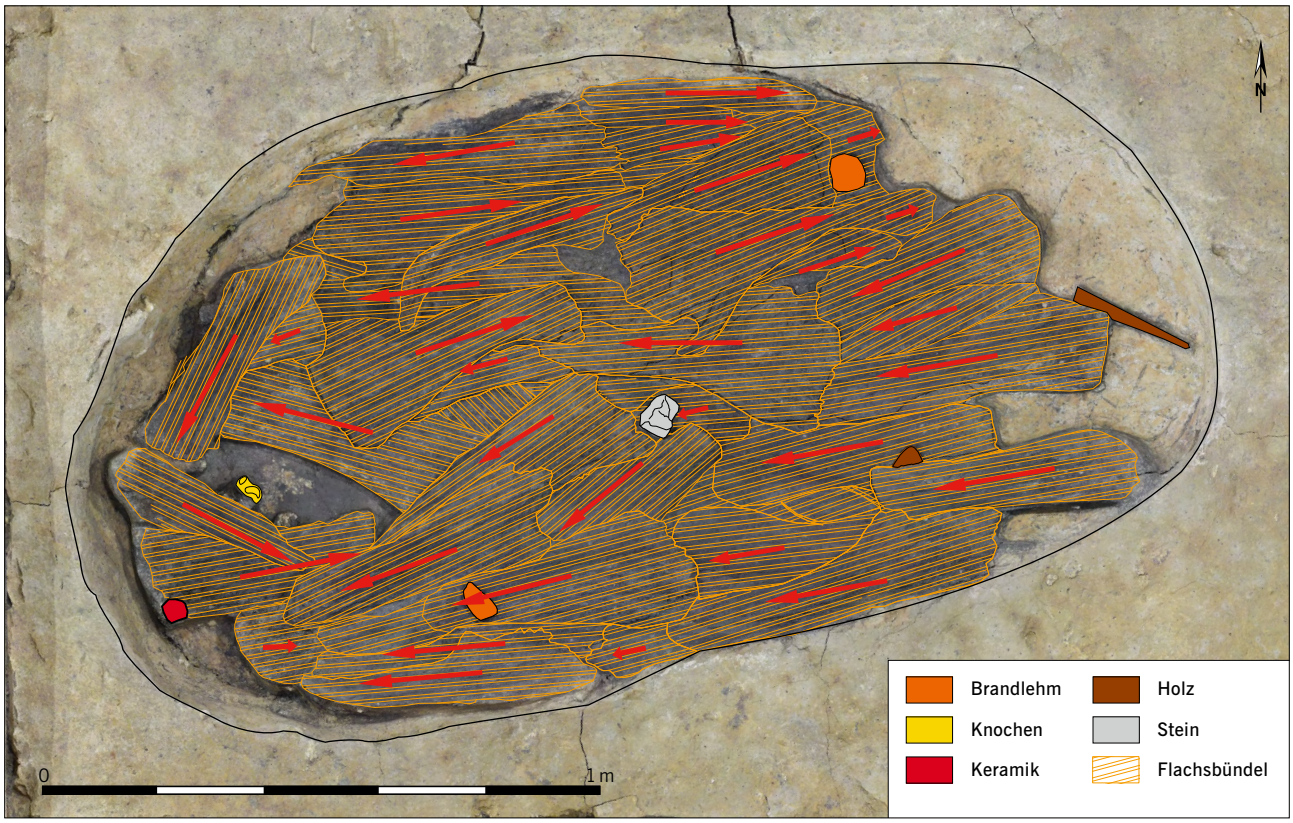


**Abb. 10** Rottegrube, Bef. 3504. Ausrichtung der Flachsbündel. Die roten Pfeile zeigen von der Wurzel weg zum Fruchtstand hin.

***Fig. 10*** *Retting pit, feature 3504. Orientation of the flax bundles. The red arrows point away from the root towards the seed heads.*

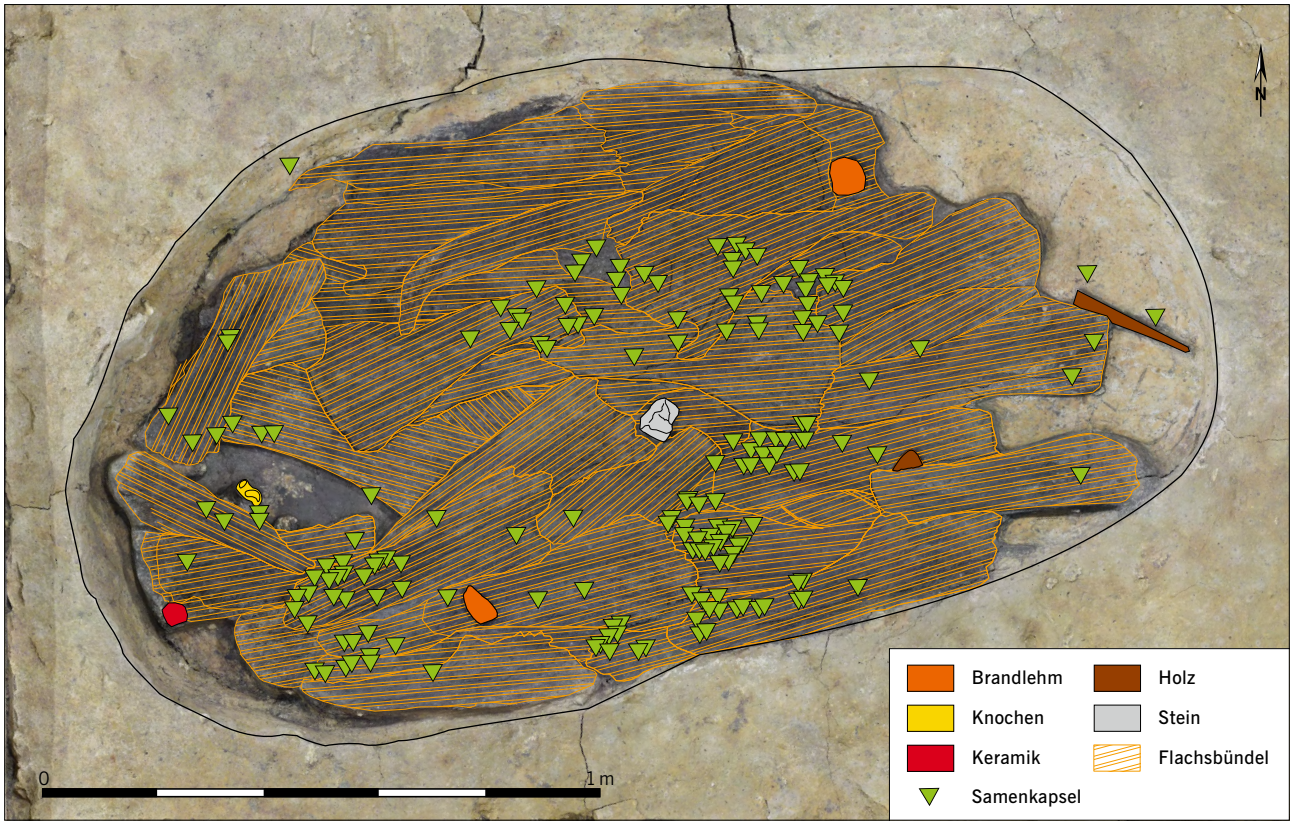


**Abb. 11** Rottegrube, Bef. 3504. Die grünen Dreiecke zeigen die Position der erhaltenen Samenkapseln an.

***Fig. 11*** *Retting pit, feature 3504. The green triangles indicate the position of the preserved seed capsules.*

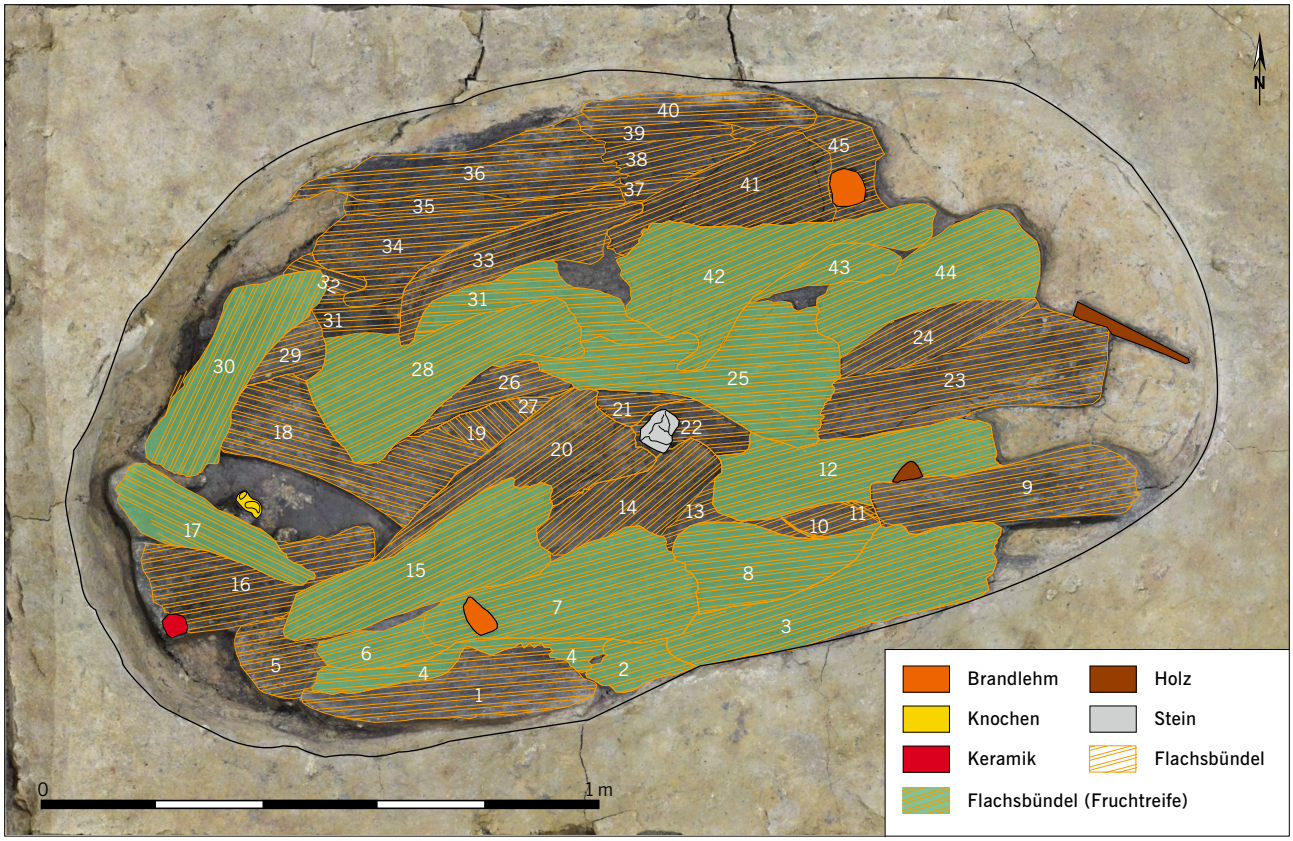


**Abb. 12** Rottegrube, Bef. 3504. Die fruchttragenden Flachsbündel sind grün hervorgehoben.

***Fig. 12*** *Retting pit, feature 3504. The seed-bearing flax bundles are highlighted in green.*

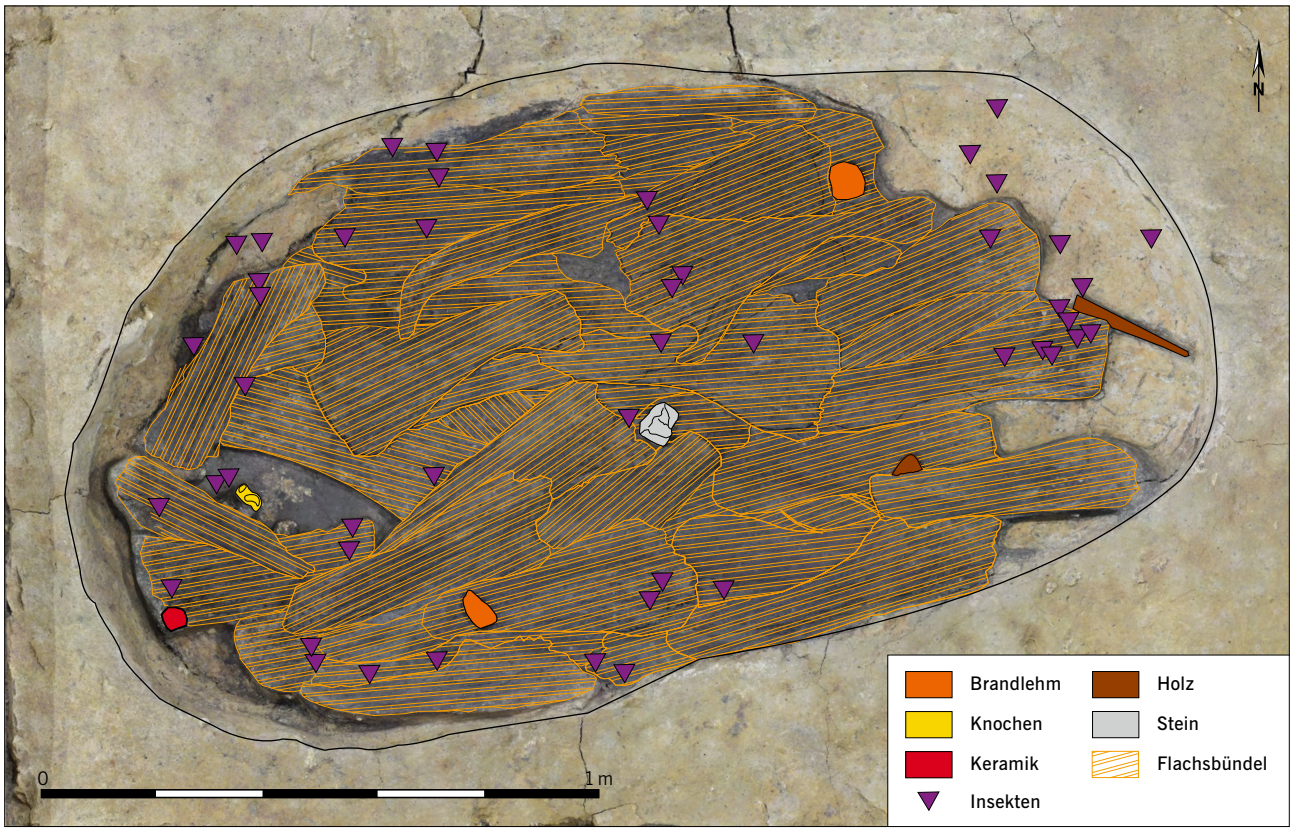


**Abb. 13** Rottegrube, Bef. 3504. Die lila Dreiecke zeigen die Position der erhaltenen Insekten an.

***Fig. 13*** *Retting pit, feature 3504. The purple triangles indicate the position of the preserved insects.*

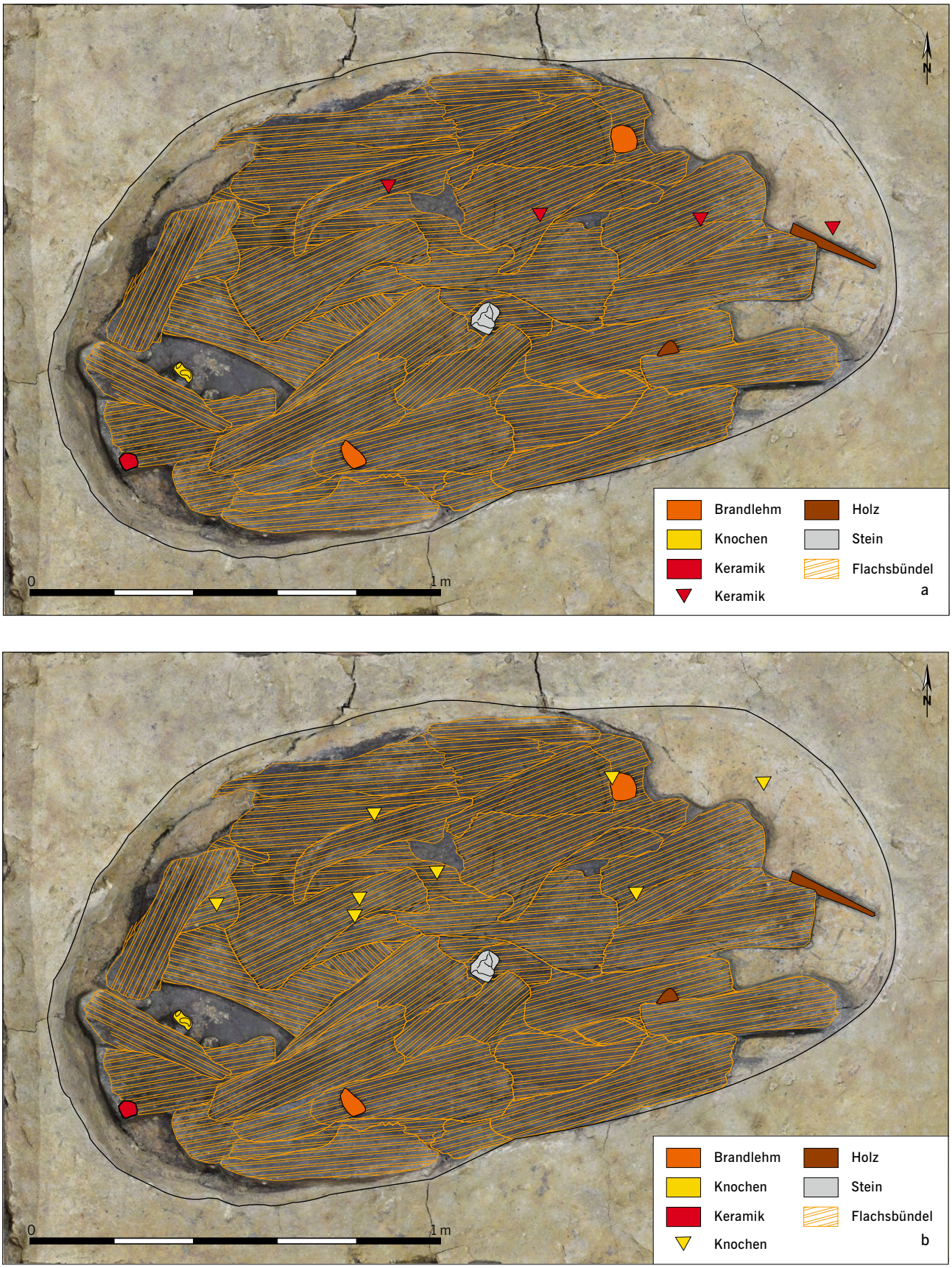


**Abb. 14a–b** Rottegrube, Bef. 3504. a Die roten Dreiecke zeigen die Position der Keramiken an. b Die gelben Dreiecke zeigen die Position der Knochen an.

***Fig. 14a–b*** *Retting pit, feature 3504. a The red triangles show the position of the ceramics. b The yellow triangles indicate the position of the bones.*

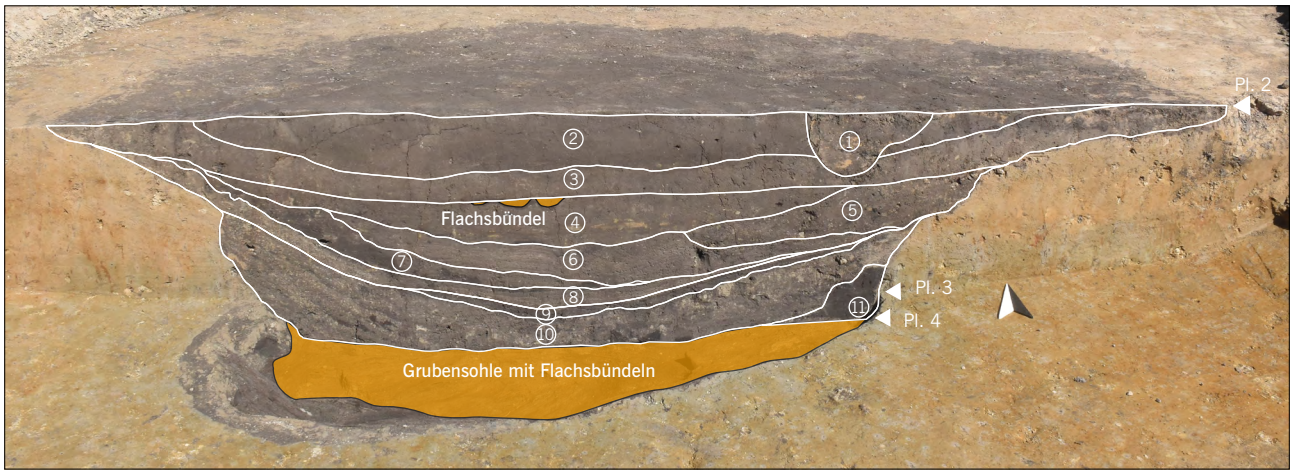


**Abb. 15** Rottegrube, Bef. 3504. Profil zwischen Pl. 1 und 4 (unmittelbar oberhalb Sohle der älteren Rottegrube; vgl. auch Tab. 4). Nicht nur in der älteren Eingrabung haben sich auf der dortigen Sohle Flachsbündel erhalten, sondern auch in der nachträglichen Eingrabung – hier zwischen Schicht 3 und 4. Die Erdeingrabung wurde demnach zweimal für den Verrottungsprozess genutzt.

***Fig. 15*** *Retting pit, feature 3504. Profile between pl. 1 and 4 (directly above the floor of the older retting pit; cf. also Tab. 4). Flax bundles were not only preserved on the floor of the older pit, but also in the later pit – here between layers 3 and 4. The earthen pit was therefore used twice for the retting process.*

| Schicht | Planum | Funde |
|---|---|---|
| 1–3 | 1–2 | 1 Fragm. Brandlehm (Fd. 2); Silex (Fd. 3); 2 Sandsteinbruchstücke (Fd. 4); 1 Tierknochen (Fd. 7) |
| 3 | 2–3 | Sandsteinbruchstück (Fd. 5); 1 Keramikhenkel, gekerbt, Mittelalter (Fd. 8); am Übergang zu Schicht 4 Reste dreier Flachsbündel |
| 4 | 2–3 | – |
| 5 | 2–3 | 1 Wandscherbe unverz., UFG (Fd. 6); 1 Tierknochen (Fd. 7) |
| 6 | 2–3 | 1 Tierknochen (Fd. 9) |
| 7 | 2–3 | – |
| 8 | 2–3 | – |
| 9 | 3–4 | 9 Insektenreste (Fd. 70–78), 3 Knochenfragm. (Fd. 59–61), 2 Fragm. Brandlehm (Fd. 64–65) |
| 10 | 3–4 | 2 Fragm. Brandlehm; 9 Wandscherben, unverz., UFG (Fd. 10, 56, 197–200), 1 Randscherbe Mittelalter (Fd. 196), 1 Tierzahn (Fd. 11), 5 Tierknochen (*in situ*, o. Fd.-Nr. und Fd. 47, 172, 194, 195); 39 Insektenreste (Fd. 108–133, 173–188); 3 Steine, Kiesel (Fd.-Nr. 201–203) |
| 11 | 3–4 | – |
| auf Flachslage | 4 | 21 Insektenreste (Fd. 14–30, 39–42), 2 Fragm. Brandlehm (*in situ*, o. Fd.-Nr.), 1 Wandungsscherbe, unverz., UFG (*in situ*, o. Fd-Nr.), 1 Stein, Geröll (*in situ*, o. Fd.-Nr.) |

**Tab. 4** Rottegrube, Bef. 3504. Übersicht zu den fundführenden Schichten (vgl. Abb. 15).

***Tab. 4*** *Großgrimma, retting pit, feature 3504. Overview of the layers containing finds (see Fig. 15).*

der in Rottegrube 3496 zum Beschweren der Flachslage genutzt worden war. Weitere ›antike‹ Tierknochen waren durch die nachgewiesenen Starkregenereignisse in die Gruben geschwemmt worden – sowohl Material aus der Römischen Kaiserzeit als auch aus dem 7.–8. Jh. n. Chr. (Bef. 3494). Der Schlitzhenkel aus Bef. 3504 würde alleine genommen schon als *terminus post quem* für die zeitliche Einordnung des für die Flachsverarbeitung angelegten Wirtschaftsareals in die Übergangszeit vom Hoch- zum Spätmittelalter ausreichen. Die zweifache Radiokarbondatierung an für den Zersetzungsprozess eingelegten Pflanzenresten lässt keinen Zweifel an der Zeitspanne zwischen ausgehendem 12. Jh. und Mitte des 13. Jhs. Die Gesamtsituation der Befunde im Zusammenspiel mit dem immer wieder entschlammten Entwässerungssystem spricht gegen eine fast tausendjährige Nutzung des Verrottungsareals, zumal die eindeutig in den mittelalterlichen Zeithorizont einzuordnende Flachsröste Bef. 3504 gleichfalls eingeschwemmte Tierknochen der Römischen Kaiserzeit enthält.

## Ausblick

Leinengewebe ist seit dem Neolithikum bekannt. In der Regel wird die Wasserröste praktiziert worden sein. Vergleichbar wenige Fundstellen belegen jedoch diesen Arbeitsschritt. Eintönig wirkende Grubencluster, erkennbar im Ausgrabungsbefund, an Luftbildern, LiDAR-Scans und geophysikalischen Messbildern, könnten vor allem im Niederungsbereich – insbesondere mit durchziehenden Grabensystemen – Beleg für das jahrtausendealte Handwerk sein.

Es erfolgte noch keine systematische Plandurchsicht großer Flächengrabungen. Bislang wurden die erst jetzt durch die gut erhaltenen Rottegruben von Großgrimma fassbaren Wirtschaftsbefunde bei der Geländearbeit nicht erkannt; die jetzt beschriebenen Spezifika wie vereinzelte Beschwerungssteine oberhalb der Sohle muldenförmiger Gruben-

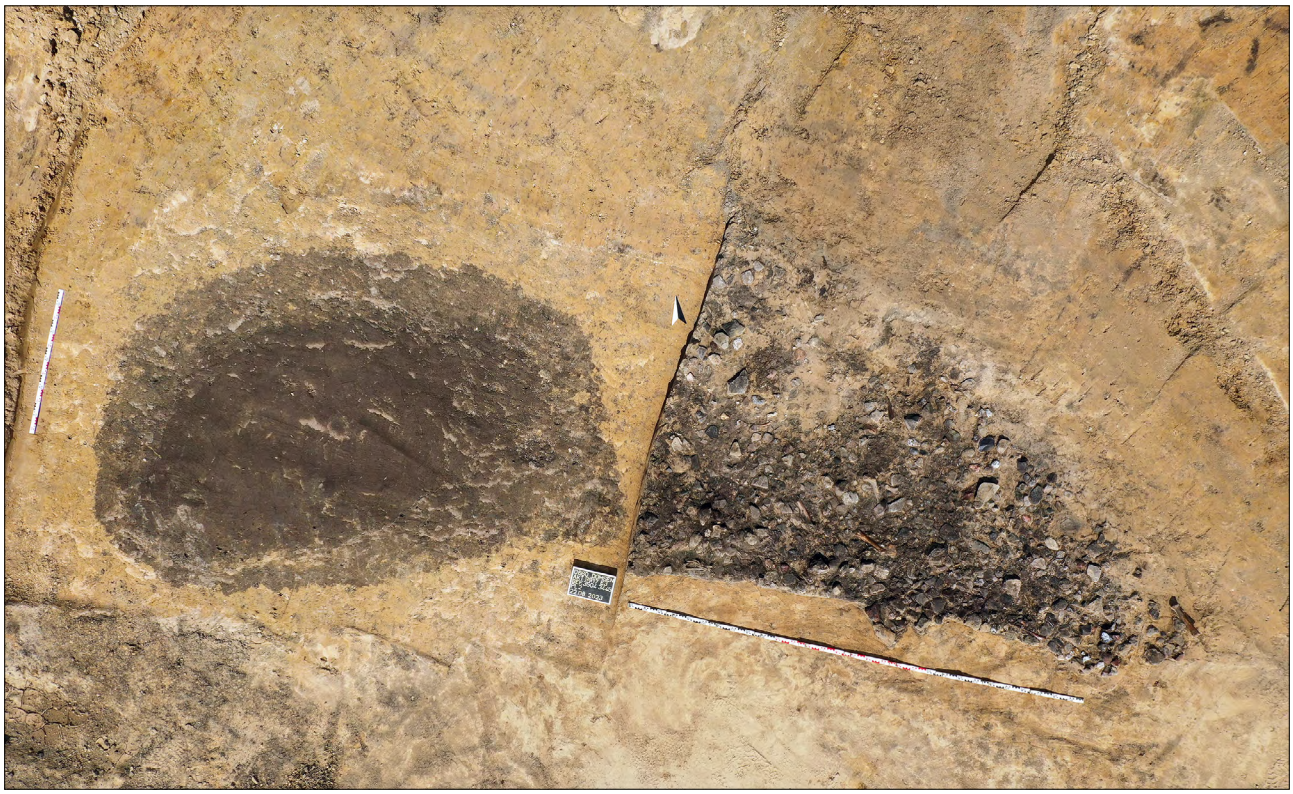

**Abb. 16** Rottegrube, Bef. 3504 (links) mit neuzeitlicher Überdeckung (Bef. 3445; rechts). In der Neuzeit wurde die noch immer feuchte Senke V (vgl. Abb. 5) mit eng gesetzten Steinen drainiert.

***Fig. 16*** *Retting pit, feature 3504 (left) with modern cover (feature 3445; right). In modern times, the still-moist depression V (cf. Fig. 5) was drained with closely placed stones.*

| Bef.-Nr. | Labor-Nr. | $^{14}$C-Alter (BP) | 1σ (68 %) | 2σ (95 %) | Bemerkung |
|---|---|---|---|---|---|
| 3351 | MAMS 76933 | 1855 ± 12 | cal AD 134–231 | cal AD 130–234 | Knochen |
| 3369 | MAMS 76935 | 1854 ± 17 | cal AD 133–233 | cal AD 129–235 | Knochen |
| 3444 | MAMS 76934 | 1826 ± 18 | cal AD 212–242 | cal AD 132–314 | Knochen |
| 3494 | MAMS 77201 | 1271 ± 12 | cal AD 684–744 | cal AD 676–773 | Knochen |
| 3496 | MAMS 77200 | 1737 ± 12 | cal AD 255–350 | cal AD 250–379 | Knochen |
| | MAMS 77202 | 1809 ± 17 | cal AD 219–306 | cal AD 210–324 | Knochen |
| 3504 | MAMS 76932 | 1739 ± 18 | cal AD 252–361 | cal AD 247–383 | Knochen |
| | MAMS 77386 | 852 ± 12 | cal AD 1179–1221 | cal AD 1169–1224 | Flachs |
| | MAMS 77387 | 842 ± 13 | cal AD 1179–1225 | cal AD 1170–1259 | Samen |
| | MAMS 77388 | 1780 ± 18 | cal AD 243–323 | cal AD 234–336 | Knochen |

**Tab. 5** Großgrimma, Rottegruben. Radiokarbondaten.

***Tab. 5*** *Großgrimma, retting pits. Radiocarbon data.*

cluster galten als natürliche Verfüllung mit anstehendem Material.

Bei einer im Vorfeld untersuchten Gleichstromtrasse zeichnen sich bei Stassfurt, Salzlandkreis, über tonigem, also wasserundurchlässigem Untergrund eindeutige Flachsrotten ab. Sie sind im Profil mulden- bis wannenförmig und unmittelbar oberhalb der Sohle – d. h. im Randbereich unmittelbar auf Planum 1 – liegen faust- bis kindskopfgroße Steine[25]. Organische Elemente haben sich nicht erhalten und zeichnen sich selbst im Profilschnitt nicht ab.

25 Geländebericht April 2025, Akt.-Nr. 18598.

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## Befundkatalog (Abb. 17)

Andrea Moser, Jonathan Schulz, Carola Oelschlägel, Susanne Baumgart,
Heiko Breuer und Susanne Friederich

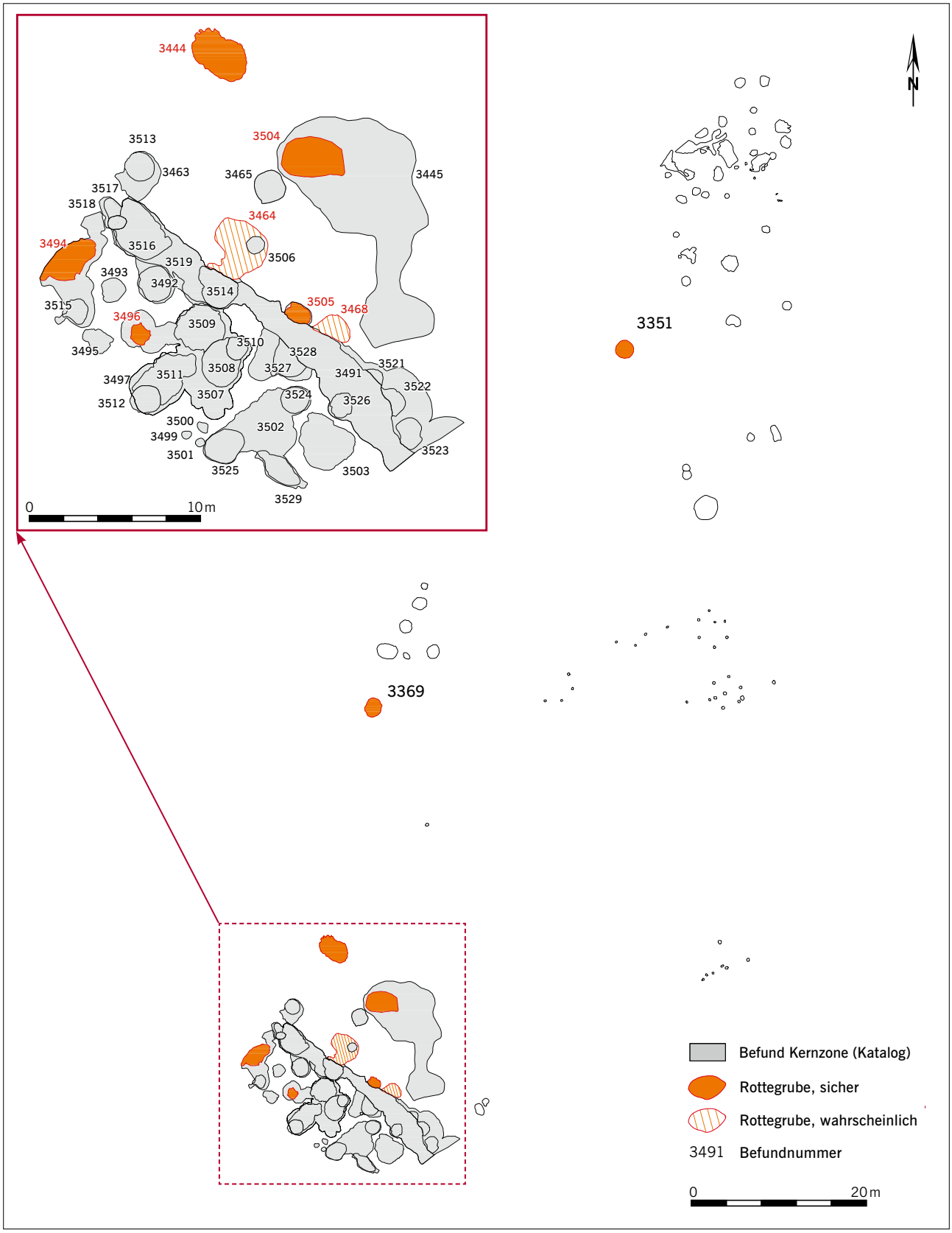


**Abb. 17** Großgrimma, Wirtschaftsareal Faserleingewinnung, Kernzone. Plan.

***Fig. 17*** *Großgrimma, production area for extracting flax fibre, core zone. Plan.*

## Befund 3351 (Rottegrube)

Runde Grube, 177 × 191 cm; Profil wannenförmig, 140 cm tief. Auf Sohle Lösslehm-Gemisch; oberer Bereich mit dunklem, schluffig-lehmigem Material verfüllt. Die Rottegrube ist in einen älteren, sich vermutlich als Geländedepression abzeichnenden Befund eingetieft (Abb. 18). Darin haben sich auf 147 cm oberhalb Sohle drei Flachsbündel erhalten (22 × 63 cm; 14 × 65 cm; 6,5 × 45,0 cm; Abb. 19–22); zwischen Fasern Mollusken (Abb. 23), belegt durch Schalenreste. Tierknochen (7 Rind; 1 Großsäuger; 1 Rothirsch [251 mm lange Geweihsprosse, vermutlich Aug- oder Mittelsprosse – feinste Rillen auf glatter Schnittfläche: vom Geweih abgesägt; Abb. 24]; 2 Schaf/Ziege; 2 unbest.).

$^{14}$C: MAMS 76933: 1855 ± 12 BP, cal AD 134–231 (68 %) bzw. cal AD 130–234 (95 %) – Knochen

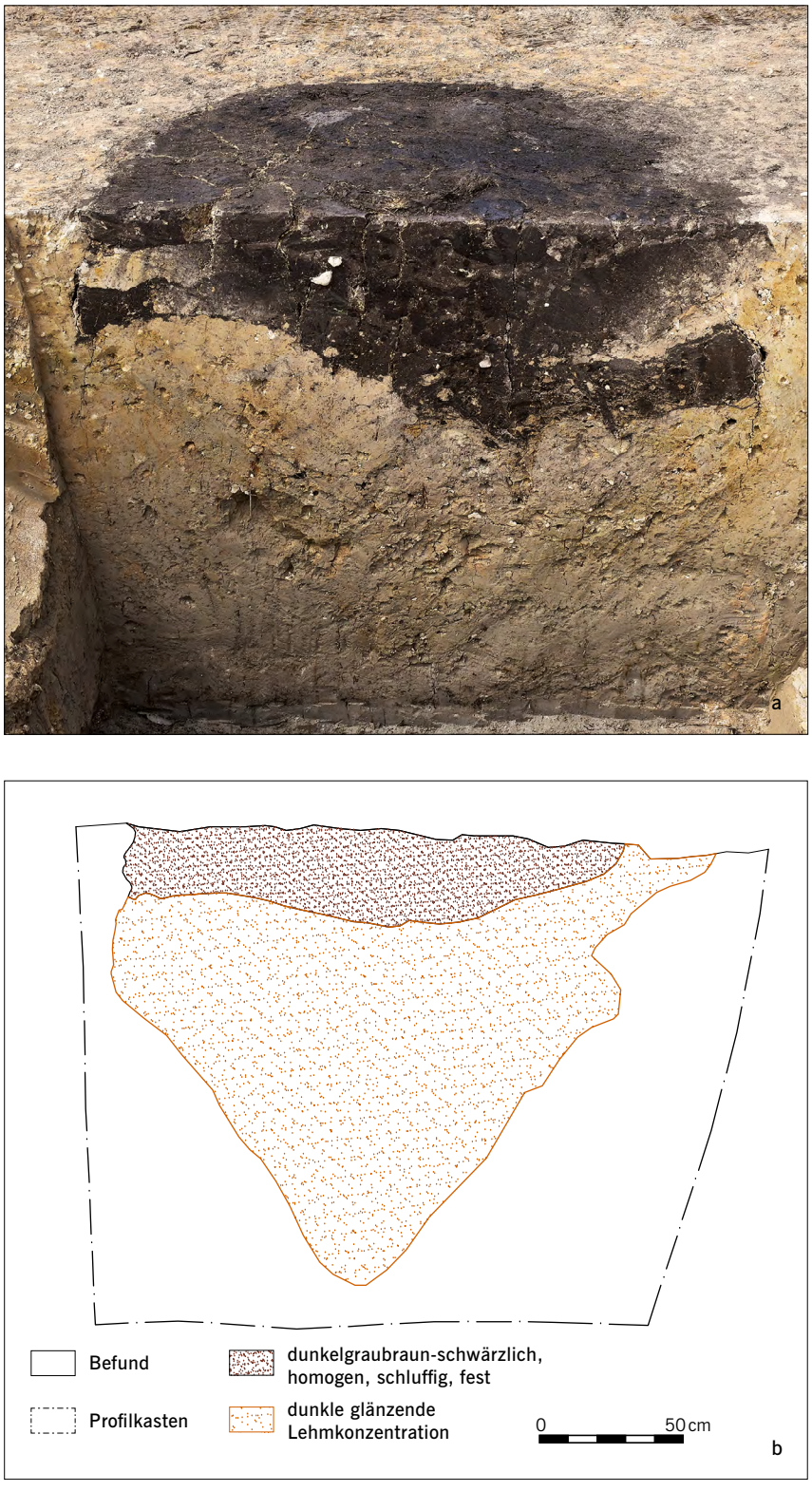


**Abb. 18a–b** Rottegrube, Bef. 3351, Profilschnitt. Die eigentliche Röstgrube ist flach muldenförmig in einen älteren, sich nur noch als Senke abzeichnenden Befund eingetieft. a Fotodokumentation; b Umzeichnung.

***Fig. 18a–b*** *Retting pit, feature 3351, profile section. The actual retting pit is shallowly cut into an older feature that is only visible as a depression. a Photo documentation; b redrawing.*

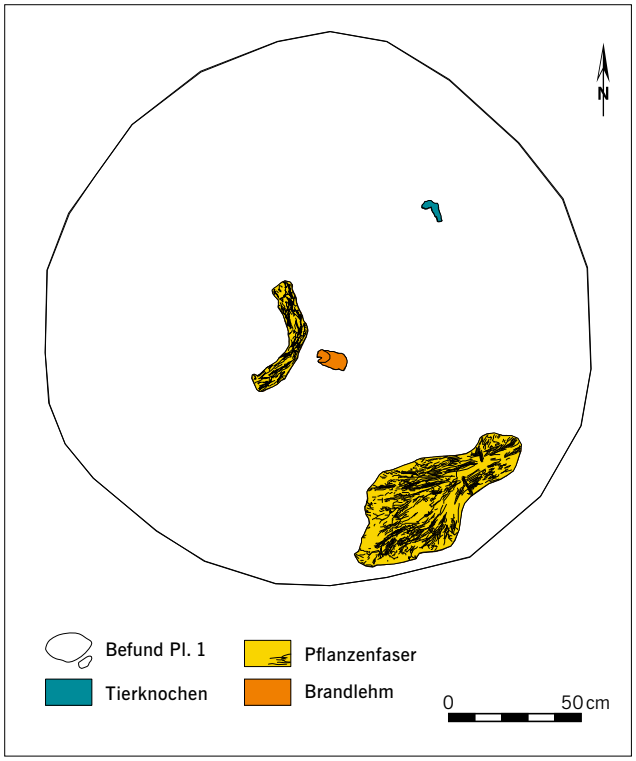


**Abb. 19** Rottegrube, Bef. 3351. Umzeichnung der Flachsbündel, die sich vor allem in der Mitte und im Randbereich der Grube erhaltenen haben.

***Fig. 19*** *Retting pit, feature 3351. Redrawing of the flax bundles, which have been preserved mainly in the centre and at the edge of the pit.*

**Abb. 20** Rottegrube, Bef. 3351. Flachsbündel.

***Fig. 20*** *Retting pit, feature 3351. Flax bundle.*

**Abb. 21** Rottegrube, Bef. 3351. Detailaufnahme Flachsbündel.

***Fig. 21*** *Retting pit, feature 3351. Detailed image of flax bundle.*

**Abb. 22** Rottegrube, Bef. 3351. Detailaufnahme Flachsbündel.

***Fig. 22*** *Retting pit, feature 3351. Detailed image of flax bundle.*

**Abb. 23** Rottegrube, Bef. 3351. Mollusken.

***Fig. 23*** *Retting pit, feature 3351. Molluscs.*

**Abb. 24** Rottegrube, Bef. 3351. Geweihsprosse.

***Fig. 24*** *Retting pit, feature 3351. Antler tine.*

**Abb. 25** Rottegrube, Bef. 3369. Die Flachsbündel sind äußerst fragil und nur beim Abtrag in natürlichen Schichten erkennbar.

***Fig. 25*** *Retting pit, feature 3369. The flax bundles are extremely fragile and only recognisable when removed in natural layers.*

## Befund 3369 (Rottegrube)

Runde Grube, 188 × 210 cm; Profil flach muldenförmig, 16 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. 15 cm oberhalb der Sohle lagen gesamtflächig verteilt fächer- bis bogenförmige Bündel aus Pflanzenfasern (Abb. 25). Zwischen den Bündeln waren einzelne Fasern oder Stängel ungerichtet und ohne erkennbare räumliche Struktur in der Grubenverfüllung eingeschlossen. Die erkennbaren Faserbündel wurden in insgesamt acht Teilblöcken geborgen (Abb. 26–30). Tierknochen (2 Rind; 14 Großsäuger; 14 unbest.).

$^{14}$C: MAMS 76935: 1854 ± 17 BP, cal AD 133–233 (68 %) bzw. cal AD 129–235 (95 %) – Knochen

**Abb. 26** Rottegrube, Bef. 3369. Umzeichnung zu Abb. 25. Es wurden acht Detailblöcke geborgen. Teilblock 8 ist aus einem tief gelegenen Abschnitt des Befundes entnommen worden.

***Fig. 26*** *Retting pit, feature 3369. Redrawing of Fig. 25. Eight detail-blocks were recovered. Partial block 8 was taken from a low-lying section of the feature.*

**Abb. 27** Rottegrube, Bef. 3369. Detailaufnahme Block 5.

***Fig. 27*** *Retting pit, feature 3369. Detailed view of block 5.*

**Abb. 28** Rottegrube, Bef. 3369. Detailaufnahme Block 5.

***Fig. 28*** *Retting pit, feature 3369. Detailed view of block 5.*

**Abb. 29** Rottegrube, Bef. 3369. Detailaufnahme Block 5.

***Fig. 29*** *Retting pit, feature 3369. Detailed view of block 5.*

**Abb. 30** Rottegrube, Bef. 3369. Detailaufnahme Block 5.

***Fig. 30*** *Retting pit, feature 3369. Detailed view of block 5.*

## Befund 3444 (Rottegrube)

Gerundet rechteckige Grube, 260 × 400 cm (Abb. 31); Profil muldenförmig, 12 cm tief (Abb. 32); mit dunklem, schluffig-lehmigem Material verfüllt. An der Sohle fünf Flachsbündel erhalten (7 × 32 cm; 8 × 50 cm; 17 × 46 cm; 16 × 32 cm; 14 × 58 cm; Abb. 33–35). Daneben 1 Tierknochen und 1 Keramikfragment. Tierknochen (3 Rind, 2 Großsäuger; 1 mittelgr. Säuger; 3 unbest.).

$^{14}$C: MAMS 76934: 1826 ± 18 BP, cal AD 212–242 (68 %) bzw. cal AD 132–314 (95 %) – Knochen

**Abb. 31** Rottegrube, Bef. 3444, Planum.

***Fig. 31*** *Retting pit, feature 3444. Planum.*

**Abb. 32 (oben)** Rottegrube, Bef. 3444, Profilschnitt.

***Fig. 32 (above)*** *Retting pit, feature 3444. Profile section.*

**Abb. 33 (rechts)** Rottegrube, Bef. 3444. Unmittelbar auf der Sohle liegen fünf Flachsbündel (in Foto drei Flachsbündel dargestellt).

***Fig. 33 (right)*** *Retting pit, feature 3444. Five bundles of flax lie directly on the floor (three bundles of flax are shown in the photo).*

**Abb. 34** Rottegrube, Bef. 3444 (Detailaufnahme zu Abb. 33).

***Fig. 34*** *Retting pit, feature 3444 (detailed photo of Fig. 33).*

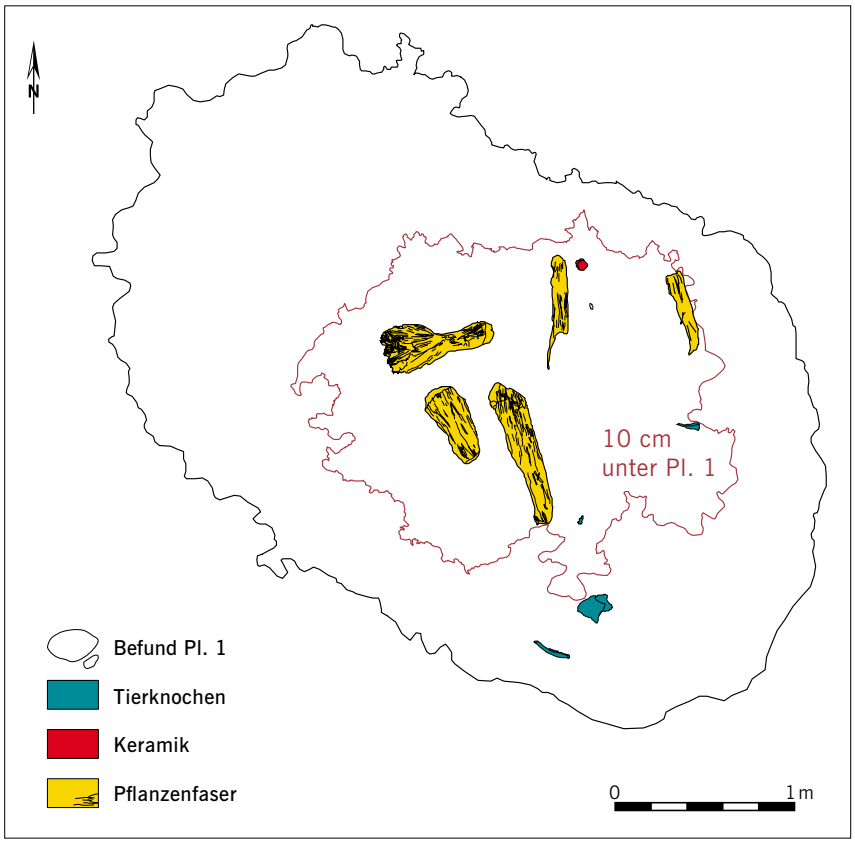


**Abb. 35** Rottegrube, Bef. 3444. Umzeichnung mit eingetragenen Flachsbündeln.

***Fig. 35*** *Retting pit, feature 3444. Redrawing with flax bundles shown.*

**Abb. 36** Neuzeitliche Pflasterung Bef. 3445 als Ausgleichslage bzw. Drainageschicht der Absenkung oberhalb der ehemaligen Rottegrube Bef. 3405.

***Fig. 36*** *Modern paving feature 3445 as a levelling layer or drainage layer of the subsidence above the former retting pit feature 3405.*

## Befund 3445

Pflasterung, 350 × 40/185/225 cm; Steine 10 × 20 cm, einlagig, v. a. Randbereich dicht gepackt, dazwischen neuzeitliche Keramik und Tierknochen (vgl. Abb. 16 u. Abb. 36).

## Befund 3463

Ovale Grube, 115 × 150 cm; im Profil wannenförmig, regelmäßige Sohle, ca. 45 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. In die Grube ist Bef. 3515 eingetieft. Zudem wird die Grube von der grabenartigen Struktur 3491 geschnitten.

## Befund 3464

Ovale Grube, 340 × 355 cm; im Profil muldenförmig, regelmäßige Sohle, ca. 20 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; im oberen Bereich Sedimentbildung in der flachen Mulde erkennbar. Die Grube wird von der grabenartigen Struktur 3491 geschnitten und überlagert Bef. 3506. Wahrscheinlich Rottegrube.

### Befund 3465

Runde Grube, Dm. 175 cm; im Profil wannenförmig, ebene Sohle, ca. 60 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; im oberen Bereich Steine und Tierknochen.

### Befund 3466

Unregelmäßig runde Grube, ca. 300 cm Dm.; im Profil muldenförmig, leicht gewellte Sohle, ca. 25 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Die Grube wird von der grabenartigen Struktur 3491 geschnitten.

### Befund 3468

Unregelmäßig rechteckige Grube, ca. 200 × 240 cm; im Profil muldenförmig, leicht gewellte Sohle, ca. 10 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Die Grube wird von der grabenartigen Struktur 3491 geschnitten. Wahrscheinlich Rottegrube.

### Befund 3492

Runde Grube, ca. 200 cm Dm.; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 50 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Die Grube wird von der grabenartigen Struktur 3491 geschnitten. Grube schneidet Bef. 3519.

### Befund 3493

Ovale Grube, ca. 135 × 155 cm; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 5 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Die Grube wird von der grabenartigen Struktur 3491 geschnitten.

### Befund 3494 (Rottegrube)

Unregelmäßige Grube, ca. 135 × 155 cm; im Profil wannenförmig, unregelmäßige flache Sohle, ca. 16 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; im Sohle-

**Abb. 37** Grabenähnliche Entwässerungsstruktur Bef. 3491, auf 25 m Länge erfasst (Querprofil). Einige Rottegruben mündeten unmittelbar ein.

***Fig. 37*** *Ditch-like drainage structure feature 3491, recorded over a length of 25 m (cross profile). Some retting pits drained directly into it.*

### Befund 3491

Graben, ca. 1–2 m breit, auf einer Länge von ca. 25 m erhalten; im Profil wannenförmig, unregelmäßige Sohle, ca. 15–40 cm tief (Abb. 37); mit dunklem, schluffig-lehmigem Material verfüllt, in dem sich verschiedene schräg-parallel verlaufende Bänder als Ergebnis verschiedener Fließereignisse abzeichnen. Der Graben schneidet die Befunde 3463, 3464, 3466, 3492, 3496, (3497 = Senke), 3498, 3502, 3503, 3505, 3514, 3516, 3526, 3528. Der Graben dürfte eine Ausbauphase der linearen Struktur 3516 darstellen.

und Randbereich Lösslehmeinschlüsse; Sedimentationsband 3–5 cm oberhalb Sohle. Im Zentrum und im Randbereich Steine von 15–20 cm Dm. (Abb. 38). Grube überlagert Bef. 3515. Tierknochen (1 Rind; 2 Pferd; 2 Großsäuger).

$^{14}$C: MAMS 77201: 1271 ± 12 BP , cal AD 684–744 (68 %) bzw. cal AD 676–773 (95 %) – Knochen

### Befund 3495

Unregelmäßige, ovale Grube, ca. 130 × 180 cm; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; in Nordwesthälfte Lösseinschlüsse.

**Abb. 38** Rottegrube, Bef. 3494, Profil. Die beiden Steine beschwerten eingebrachte, jedoch nur noch durch Bodenverfärbungen erkennbare Flachsbündel. Diese mussten während des Fäulnisprozesses ständig unter Wasser bleiben; Faulgas durfte die Pflanzenstängel nicht auftreiben.

***Fig. 38*** *Retting pit, feature 3494, profile. The two stones weighed down bundles of flax that had been brought in but were only recognisable by soil discoloration. The flax had to remain constantly submerged during the decomposition process; fermentation gas had to be prevented from raising the plant stems.*

**Abb. 39** Rottegrube, Bef. 3496, Zwischenplanum. Im Randbereich Stein (20 × 30 cm). Dieser bewahrte an seiner Unterseite Fasern und Samenkapseln von Flachs (vgl. Abb. 40).

***Fig. 39*** *Retting pit, feature 3496, intermediate planum. Stone (20 × 30 cm) in the edge area. This preserved flax fibres and seed capsules on its underside (see Fig. 40).*

## Befund 3496 (Rottegrube)

Achtförmige Grube, ca. 290 × 220 cm; im Profil wannenförmig, unregelmäßige flache Sohle, ca. 16 cm tief. Die Rottegrube wurde in einen älteren, sich noch als Geländepression abzeichnenden Befund der Römischen Kaiserzeit eingetieft (Abb. 39); es kam zur Vermischung mit älterem Material. Rottegrube mit dunklem, schluffig-lehmigem Material verfüllt; mittelgraue Bänderung durch Lösseinschwemmung. Auf Sohle großer Stein von 20 × 30 cm, an dessen Unterseite sich Fasern und Samenkapseln von Flachs erhalten haben (Abb. 40). Bruchstück einer blauen Perle (Abb. 41); Bronzebruchstück (Abb. 42). Tierknochen (17 Rind; 5 Schwein; 3 Pferd; 10 Großsäuger; 1 Schaf/Ziege; 6 unbest.). Gesamtes Os frontale und Teile des Os parietale eines Rinderschädels erhalten (Abb. 43); Loch auf der Stirn Hinweis auf Betäubungsschlag vor Tötung; Spuren vom Schlachtvorgang und späterer Zerteilung (feine Schnittspuren um Hornzapfenbasis: Häuten des Tieres oder Entfernen der Hornscheiden); mittelalterliche Keramik.

$^{14}$C: MAMS 77200: 1737 ± 12 BP, cal AD 255–350 (68 %) bzw. cal AD 250–379 (95 %) – Knochen

$^{14}$C: MAMS 77202: 1809 ± 17 BP, cal AD 219–306 (68 %) bzw. cal AD 210–324 (95 %) – Knochen

**Abb. 40** Rottegrube, Bef. 3496. An der Unterkante eines Beschwerungssteins fiel der Mineralboden niemals trocken; Flachsfasern und Leinsamen haben sich erhalten.

***Fig. 40*** *Retting pit, feature 3496. At the lower edge of the heavy stone the mineral soil never dried out; flax fibres and flax seeds have been preserved there.*

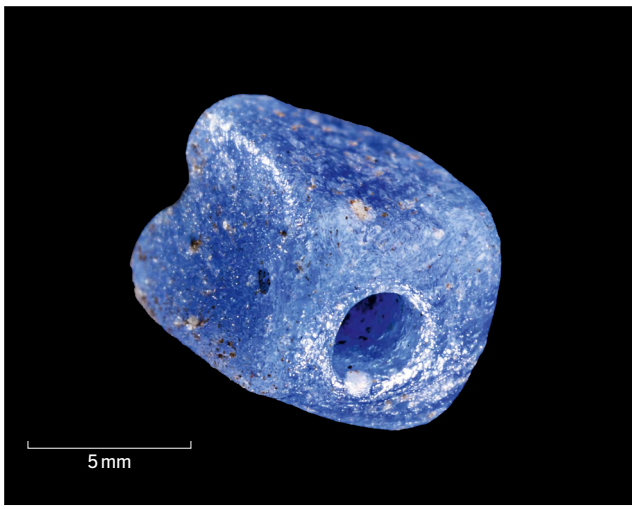


**Abb. 41** Bef. 3496. Perle blau (Römische Kaiserzeit) aus Befund unterhalb Rottegrube Bef. 3496.

***Fig. 41*** *Feature 3496. Blue bead (Roman Imperial period) from feature below retting pit, feature 3496.*

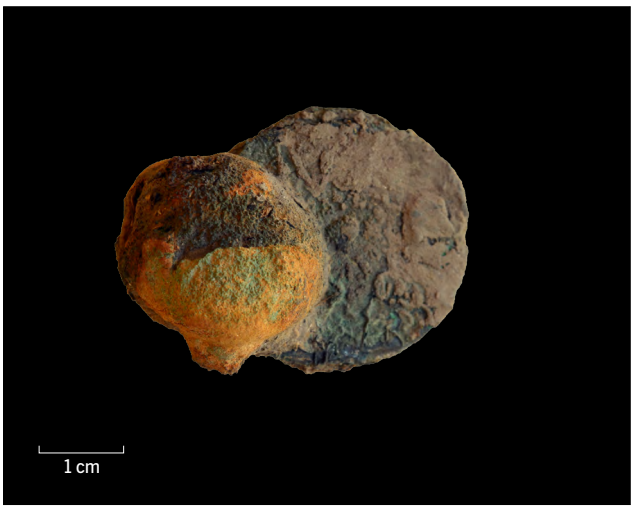


**Abb. 42** Bef. 3496. Bronzefragment (Römische Kaiserzeit) aus älterer Grube unterhalb Rottegrube Bef. 3496.

***Fig. 42*** *Feature 3496. Bronze fragment (Roman Imperial period) from older pit below retting pit, feature 3496.*

**Abb. 43** Bef. 3496, Rinderschädel mit Loch in Stirn. Ähnliche Rinderschädel mit Hinweis auf einen Betäubungsschlag liegen aus der älteren Siedlung der Römischen Kaiserzeit vor – entweder aus älterer Grube unterhalb Rottegrube Bef. 3496 oder anderer Stelle des älteren Siedlungsplatzes.

***Fig. 43*** *Feature 3496, cattle skull with hole in forehead. Similar cattle skulls with evidence of concussion stunning are present from the older settlement of the Roman Imperial period – either from an older pit below the retting pit feature 3496 or from other parts of the older settlement site.*

### Befund 3497

Unregelmäßiger runder Befund/Schicht (Verfüllung einer Senke), ca. 700 × 800 cm; mit dunklem, schluffig-lehmigem Material verfüllt. Überlagert die Bef. 3507–3512.

### Befund 3498

Runde Grube, 135 cm Dm.; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Die Grube wird von der grabenartigen Struktur 3491 geschnitten.

### Befund 3499

Runde Grube, ca. 50 cm Dm.; im Profil wannenförmig, ca. 10 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; Lösslehmeinschlüsse.

### Befund 3500

Runde Grube, ca. 55 cm Dm.; im Profil wannenförmig, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; Lösslehmeinschlüsse und Bänderung im unteren Bereich.

### Befund 3501

Runde Grube, ca. 40 cm Dm.; im Profil wannenförmig, ca. 10 cm tief; mit beigem, schluffig-lehmigem Material verfüllt; feine Bänderung.

### Befund 3502

Unregelmäßige, ovale Grube, ca. 500 × 700 cm; im Profil wannenförmig, schräger Sohlenverlauf, ca. 30 cm tief; graue Bänderung ca. 3–5 cm oberhalb Sohle; darüber Lösslehmeinschlüsse (Starkregenereignis). Mögliche Verbindung zu grabenartiger Struktur 3491. Grube wird von Bef. 3525 geschnitten.

### Befund 3503

Rundovale Grube, ca. 260 × 320 cm; im Profil wannenförmig, unregelmäßig flache Sohle, ca. 35 cm tief; mit braunem, schluffig-lehmigem Material verfüllt; feine Bänderung. Die Grube wird von der grabenartigen Struktur 3491 geschnitten. Unklarer Bezug zu Bef. 3524.

### Befund 3504 (Rottegrube)

Gerundet rechteckige Grube, ca. 235 × 360 cm; Profil wannenförmig, ca. 80 cm tief (Abb. 44–45); mit dunklem, schluffig-lehmigem Material verfüllt. Auf der nach Westen

hin abfallenden Sohle (Abb. 46) 47 Flachsbündel (Länge variiert zwischen 35 und 65 cm; vgl. Tab. 2). Der gesamte Grubenboden ist in zwei ineinandergreifenden Lagen von Flachsbündeln bedeckt (vgl. Abb. 7; Abb. 47). Sie sind fast alle gleichlaufend ausgerichtet; am Westrand der Grube liegen drei anders orientierte Bündel (vgl. Abb. 10). Die in der zweiten Lage eingebrachten Flachsbündel weisen Samenkapseln auf (Abb. 48–49). Im tieferen Bereich der Grube, vor allem im südlichen Abschnitt des Befundes Insektenreste an Flachsfasern anhaftend. Auf Flachsbündel drei faustgroße Steine (Tab. 3). Auf der oberen Lage der Flachsbündel Keramik (Abb. 50–51 Schlitzhenkel); diese gibt als *terminus post quem* Übergang Hoch-/Spätmittelalter (um 1200 n. Chr.).

Oberhalb der Grube befindet sich ein mittelalterliches bis neuzeitliches Pflaster (Bef. 3445). Die zu den Befundrändern hin ausdünnende, mit Tierknochen durchsetzte Pflasterung ist als Maßnahme zur Trockenlegung einzustufen (vgl. Abb. 16; Abb. 36). Demnach dürfte sich die Rottegrube zu dieser Zeit noch als feuchte Senke im Gelände abgezeichnet haben.

$^{14}$C: MAMS 76932: 1739 ± 18 BP, cal AD 252–361 (68 %) bzw. cal AD 247–383 (95 %) – Knochen

$^{14}$C: MAMS 77386: 852 ± 12 BP, cal AD 1179–1221 (68 %) bzw. cal AD 1169–1224 (95 %) – Flachs

$^{14}$C: MAMS 77387: 842 ± 13 BP, cal AD 1179–1225 (68 %) bzw. cal AD 1170–1259 (95 %) – Samenkapsel

$^{14}$C: MAMS 77388: 1780 ± 18 BP, cal AD 243–323 (68 %) bzw. 234–336 (95 %) – Knochen

**Abb. 44** Rottegrube, Bef. 3504, Profil und Planum, 5 cm oberhalb Sohle. Dort zeichnen sich deutlich Flachsbündel ab. Dezimeter weiter oben liegende Flachsbündel belegen, dass die durch Starkregenereignisse fast vollkommen mit Sediment zugelaufene Grube nochmals als Faulröste genutzt wurde. Nochmals überdeckte Schlamm die in die Wirtschaftsgrube eingebrachten Pflanzenstängel (vgl. Abb. 45).

***Fig. 44*** *Retting pit, feature 3504, profile and planum, 5 cm upper neck level. There, flax bundles are clearly visible. Flax bundles lying decimetres higher prove that the pit, which was almost completely filled with sediment due to heavy rainfall, was reused as a retting pit. Silt once again covered the plant stems introduced into the pit (see also Fig. 45).*

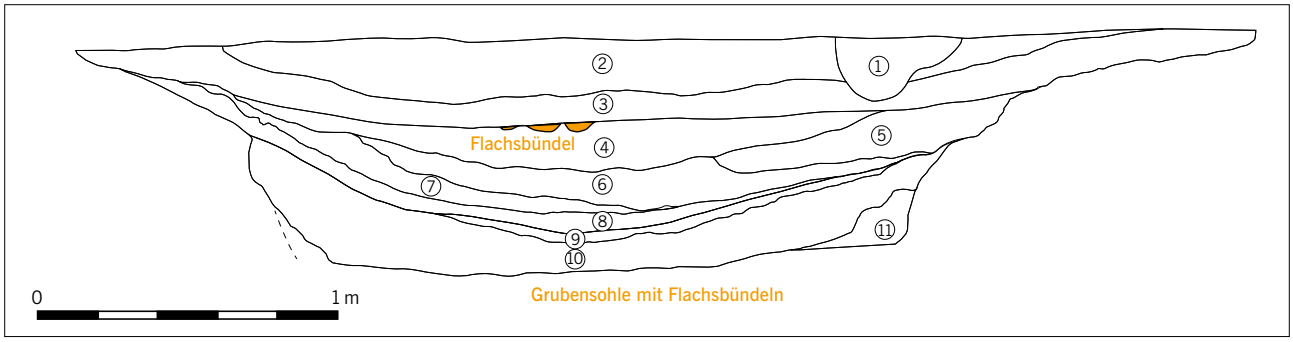


**Abb. 45** Rottegrube, Bef. 3504, Profil. Grafische Darstellung der Einfüllschichten (vgl. Abb. 15 mit Tab. 4).

***Fig. 45*** *Retting pit, feature 3504, profile. Graphic representation of the infilling layers (see Fig. 15 with Tab. 4).*

**Abb. 46** Rottegrube, Bef. 3504. Orthofoto Fundlage oberhalb Sohle der ersten Rottegrube.

***Fig. 46*** *Retting pit, feature 3504. Orthophoto of the find location above the floor of the first retting pit.*

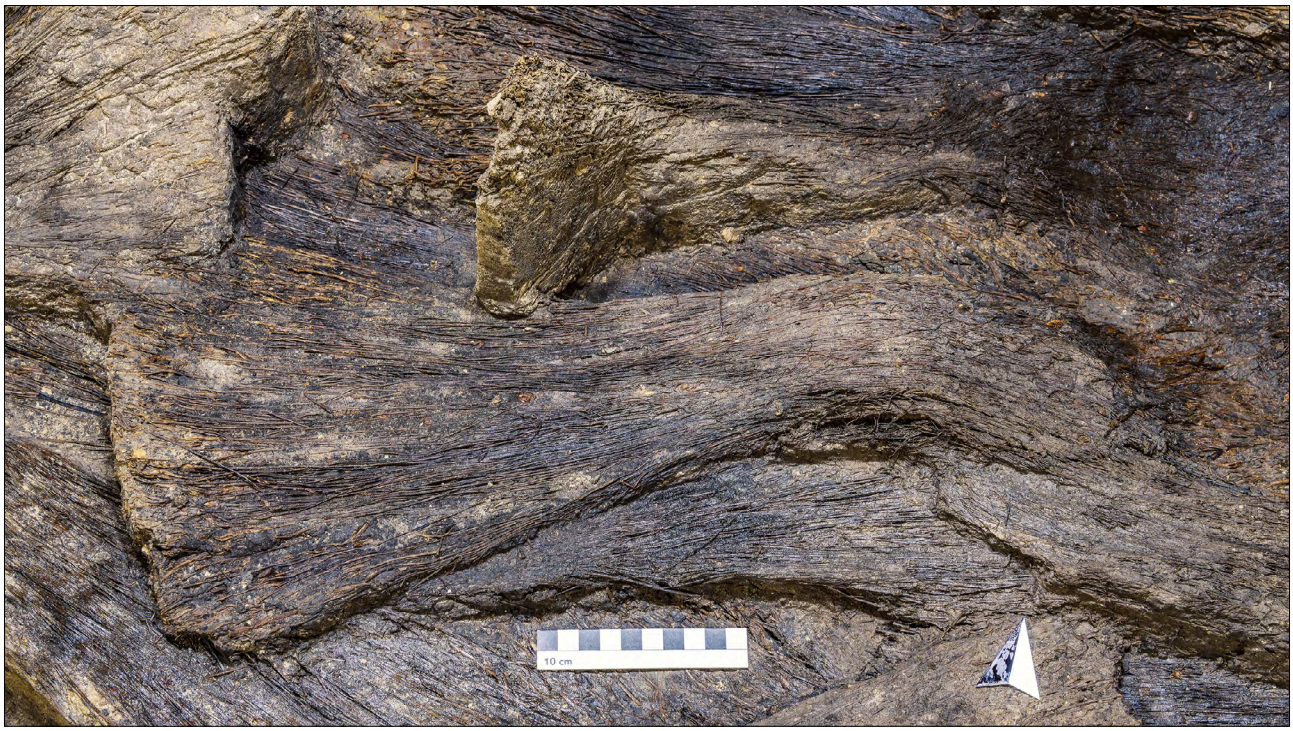


**Abb. 47** Rottegrube, Bef. 3504. Fundlage auf Grubensohle (vgl. auch Abb. 7).

***Fig. 47*** *Retting pit, feature 3504. Finds on the pit floor (see also Fig. 7).*

**Abb. 48** Rottegrube, Bef. 3504. An einigen Flachsbündel haften Leinsamen.

***Fig. 48*** *Retting pit, feature 3504. Flax seed adheres to some flax bundles.*

**Abb. 49** Rottegrube, Bef. 3504 (Detailaufnahme zu Abb. 48). Leinsamen.

***Fig. 49*** *Retting pit, feature 3504 (detailed view of Fig. 48). Flax seeds.*

**Abb. 50** Rottegrube, Bef. 3504. Mit den Schlammmassen (Starkregenereignis) wurde auch Keramik in die Wirtschaftsgrube gespült.

***Fig. 50*** *Retting pit, feature 3504. Along with masses of mud (heavy rainfall event) pottery was also washed into the pit.*

**Abb. 51** Rottegrube, Bef. 3504. Schlitzhenkel. Oberster Verfüllbereich.

***Fig. 51*** *Retting pit, feature 3504. Slotted handle. Upper backfill area of.*

### Befund 3505 (Rottegrube)

Am Rande eines Grubenclusters runde Grube, Dm. ca. 175 cm (Abb. 52); Profil flach muldenförmig, 7 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Wenige cm oberhalb der Sohle ein Flachsbündel erhalten (10 × 28 cm; Abb. 53) und ein Rindensegment (10 × 12 cm). Organik nicht konserviert. Tierknochen (1 Rind; 1 Schwein; 1 Pferd; 9 unbest.).

### Befund 3506

Runde Grube, ca. 100 cm Dm.; im Profil kastenförmig, unregelmäßige Sohle, ca. 30 cm tief. Grube wird von Bef. 3464 (wahrscheinlich Rottegrube) überlagert.

### Befund 3508

Unregelmäßig ovale Grube, 220 cm im Dm.; im Profil wannenförmig, ca. 30 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt.

### Befund 3509

Kastenbrunnen – runde Brunnengrube, 275 cm im Dm.; 9 erhaltende Bohlenzüge erhalten; Tiefe 140 cm.

### Befund 3510

Runde Grube, ca. 135 cm Dm.; im Profil muldenförmig, unregelmäßige Sohle, ca. 10 cm tief. Grube schneidet Bef. 3508.

### Befund 3511

Unregelmäßig ovale Grube, 220 cm im Dm.; im Profil wannenförmig, ca. 10 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; oberer Abschnitt eingespült. Grube wird von Bef. 3512 überlagert.

### Befund 3512

Runde Grube, ca. 175 cm Dm.; im Profil muldenförmig, unregelmäßige Sohle, ca. 20 cm tief. Grube schneidet Bef. 3511.

**Abb. 52** Rottegrube, Bef. 3505. Planum oberhalb Sohle.

***Fig. 52*** *Retting pit, feature 3505. Planum above the floor.*

**Abb. 53** Rottegrube, Bef. 3505. Flachsbündel (Detail zu Abb. 52).

***Fig. 53*** *Retting pit, feature 3505. Flax bundle (detail of Fig. 52).*

### Befund 3514

Oval-rechteckige Grube, ca. 100/175 × 200 cm; im Profil wannenförmig, ca. 35 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; unklar, ob Einschlüsse von Schlacke. Die Struktur wird von der grabenartigen Struktur 3491 geschnitten.

### Befund 3515

Runde Grube, ca. 140 cm Dm.; im Profil muldenförmig, unregelmäßige Sohle, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt.

### Befund 3516

Lineare Struktur, ca. 40 cm breit, auf eine Länge von ca. 500 cm erhalten; im Profil mulden- bis wannenförmig, unregelmäßige Sohle, ca. 45 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt; im unteren Bereich gebändert, im oberen Bereich Lösseinschlüsse. Die Struktur überdeckt den Röhrenbrunnen Bef. 3518 und wird von der grabenartigen Struktur Bef. 3491 überlagert.

### Befund 3517

Ovale Grube, 140 × 150 cm; im Profil mulden- bis wannenförmig, unregelmäßige Sohle, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt.

### Befund 3518

Rundliche Grube, 70 × 80 cm; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Im Randbereich erkennbares Holz zeigt eine Versteifung mittels Röhre mit Wandstärke von 3–5 cm an (ausgehöhlter Baumstamm?).

### Befund 3519

Muldenförmige Schicht; flacher hangparalleler Sohlenverlauf, ca. 24 cm tief; mit dunklem Material verfüllt, teilweise gebändert. Schicht überfließt Bef. 3516; wird von Bef. 3514 und Bef. 3492 geschnitten.

### Befund 3521

Unregelmäßige Struktur, ca. 60 × 135 cm; im Profil muldenförmig, unregelmäßige Sohle, ca. 15 cm tief. Struktur wird von grabenartiger Struktur 3491 überlagert. Eventuell handelt es sich um eine ältere Fließstruktur.

### Befund 3522

Ovale Struktur, ca. 120 × 170 cm; im Profil muldenförmig, unregelmäßige Sohle, ca. 15 cm tief. Struktur wird von grabenartiger Struktur 3491 überlagert. Eventuell handelt es sich wie bei Bef. 3521 um eine ältere Fließstruktur.

### Befund 3523

Ovale Struktur, ca. 110 × 160 cm; im Profil muldenförmig, unregelmäßige Sohle, ca. 10 cm tief. Struktur wird von grabenartiger Struktur 3491 überlagert. Eventuell handelt es sich um eine ältere Fließstruktur.

### Befund 3524

Runde Grube, ca. 160 cm Dm.; im Profil wannenförmig, getreppte flache Sohle, ca. 10 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Grube wird von Bef. 3502 geschnitten.

### Befund 3525

Ovale Grube, 200 × 250 cm; im Profil muldenförmig, unregelmäßige Sohle, ca. 25 cm tief. Untere Schichten hangabwärts über Befund 3502 (geflossen).

### Befund 3526

Runde Grube, 135 cm Dm.; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 15 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Die Grube wird von der grabenartigen Struktur 3491 geschnitten.

### Befund 3527

Runde Grube, 30 cm Dm.; im Profil muldenförmig, unregelmäßige flache Sohle, ca. 15 cm tief; mit mittelbraunem, schluffig-lehmigem Material verfüllt. Verfüllte Bodendelle, gehört zu Bef. 3491.

### Befund 3528

Rundliche Grube, 180 × 210 cm; im Profil wannenförmig, unregelmäßige flache Sohle, ca. 60 cm tief; mit dunklem, schluffig-lehmigem Material verfüllt. Bänderung, mit Hinweisen auf Organik im unteren Bereich, zeigt Fließereignisse an. Die Grube wird von der grabenartigen Struktur 3491 geschnitten.

### Befund 3529

Rundliche Grube, 130 × 300 cm; im Profil muldenförmig, ca. 10 cm tief; mit mittelbraunem, schluffig-lehmigem Material verfüllt.

## Abbildungsnachweis

| | |
|---|---|
| 1 | A. Swieder, LDA; Kartengrundlage: Sächsisches Meilenblatt Nr. 7 © Staatsbibliothek zu Berlin – Preußischer Kulturbesitz; Fließgewässer © Landesbetrieb für Hochwasserschutz und Wasserwirtschaft Sachsen-Anhalt (LHW) |
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| 3–5 | Y. Gottwald, LDA |
| 6 | a Y. Gottwald, LDA; b A. Moser |
| 7 | K. Bentele, LDA |
| 8 | Y. Gottwald, LDA |
| 9 | H. Schulze, GALA, Y. Gottwald, LDA |
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| 44–45 | J. Schulz |
| 46 | K. Bentele, LDA; J. Schulz |
| 47–51 | K. Bentele, LDA |
| 52–53 | R. Ronneburg, GALA |
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| Tab. 2 | J. Schulz |
| Tab. 3–4 | J. Schulz, C. Oelschlägel, S. Baumgart |
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# Old spindle whorls – new yarn. The functionality of different types of whorls in practical use based on a case study of Feddersen Wierde, Cuxhaven District

Martha Görlitz

**Zusammenfassung**

Alte Spinnwirtel – neue Garne. Die Funktionsweise verschiedener Spinnwirteltypen im praktischen Gebrauch am Beispiel der Feddersen Wierde, Lkr. Cuxhaven

*Über die Faktoren, die für die Funktionalität eines Spinnwirtels ausschlaggebend sind, wird in der Textilforschung noch immer debattiert. So soll etwa eine regelmäßige Form oder eine zentral verlaufende Lochung als Kriterium für die Definition eines Wirtels gelten. In der Praxis stellen diese Punkte jedoch keine Hindernisse dar: Das Spinnen eines Fadens in konstanter Dicke mit einem dezentral gelochten, ungleichmäßig zugerichteten Scherbenrondell ist genauso möglich wie die Fadenproduktion mit einer rotierenden Kartoffel. Daneben wird das Gewicht oftmals als ausschlaggebender Punkt für die Garnstärke angesehen. Dem gegenüber stehen Versuchsreihen, die zeigen, dass sowohl leichte als auch schwere Wirtel die Produktion eines breiten Spektrums an Garnstärken ermöglichen. Um zu klären, inwiefern das Gewicht oder die äußere Form eines Spinnwirtels mit dessen Rotationsdauer und den sich daraus ergebenen funktionalen Eigenschaften in Zusammenhang stehen, wurden die Spinnwirtel der Wurtensiedlung Feddersen Wierde, Lkr. Cuxhaven, unter festgelegten Parametern in einer Versuchsreihe angesponnen. Die Ergebnisse lassen auf einen Zusammenhang zwischen Wirteltypen und Spinntechniken schließen.*

**Schlagwörter** Spinnwirtel, Handspindel, Garnproduktion, Spinntechniken, Rotationseigenschaften

**Summary**

*The factors that determine the functionality of a spindle whorl are still being debated in textile research. For example, a regular shape or a perforation running through the centre of a whorl are criteria often put forward for its definition. In practice, however, these aspects are not obligatory for a whorl's function. It is just as possible to spin a thread of constant thickness with a decentrally perforated, unevenly worked shard or even a rotating potato. In addition to the contradictions in object definition, weight is often cited as the determining factor for thread thickness. In contrast, test series show that entirely different whorls of greatly varying weight allow the production of a wide range of yarn diameters. To clarify the extent to which the weight or the shape of a spindle whorl relates to its rotation time and the resulting functional properties, spindle whorls from the Roman Iron Age terp village of Feddersen Wierde, Cuxhaven District, were used in a series of tests under defined parameters. The results suggest a strong functional correlation between whorl types and spinning techniques.*

**Keywords** Spindle whorls, hand spindle, yarn production, spinning techniques, rotation properties

## Introduction – the definition of a spindle whorl

»If I devote a special section of my text to spindle-whorls I do so with apologies [...]. I suppose that it was Schliemann who first brought the spindle-whorl into prominence – a venial error in his case, but today there is no excuse for wasting space and money on this monotonous and profitless material« (Woolley 1955, 271).

Even though almost 70 years have passed since these lines were written, the quote well reflects the attitude towards a type of find that probably has remained in use for the past 12 000 years (Yashuv/Grosman 2024). Basically, spindle whorls represent a group of objects that are insufficiently mentioned in the literature and do not receive as much research attention as other finds.

In textile research, there is constant debate as to which objects can be considered spindle whorls. Numerous authors[1] argue that the function of a spindle whorl depends strongly on the location of its perforation, claiming that it must run as close and straight as possible along the object's median; this is seen as a criterion for the definition of an object as a whorl. It is argued that the imbalance caused by a perforation that is not located centrally would lead to uneven thread production and thus disqualify such objects as whorls. However, these claims could not be confirmed in practice. On the one hand, rotational imbalances can be compensated with

1 E.g. Crewe 1998, 13–14; Barber 1991, 54; Barber 1994, 38; Grömer 2004, 179; Völling 2008b, 110; Carington Smith 1992, 674.

**Fig. 1a–b** a Spinning with a potato in a self-experiment. The tuber can be used as a whorl without any problems. b A uniform thread is produced.

***Abb. 1a–b*** *a Spinnen mit einer Kartoffel im Selbstversuch. Die Knolle kann ohne Probleme als Wirtel verwendet werden. b Es wird dabei ein gleichmäßiger Faden hergestellt.*

the spindle stick, and on the other hand, they do not necessarily result in uneven yarn production. On the contrary, an object perforated aside from its median that has an outwardly oriented mass distribution can still be spun without any problems using the drop spindle technique.

In addition, some authors have claimed that having a perforation of less than 4 mm in diameter (Carington Smith 1992, 675) or a biconical, i.e. hourglass shape (Liu 1978, 97) would disqualify such objects from being used as whorls. In contrast, a conical perforation is seen as an indicator for an object's use as a spindle whorl (Höllhuber 1981, 82; 88–90).

As mass roughly correlates with size, objects whose dimensions are too small would be disqualified as whorls according to some authors[2]. However, experimental studies show that it is quite possible to spin with rather light objects, even those weighing less than 10 g (Mårtensson et al. 2006a; Mårtensson et al. 2006b). In addition, so-called ›bead whorls‹, still attached to the spindle sticks wrapped in spun yarn, have survived from Peru in weaving baskets (Liu 1978, 90 Fig. 2; 96; 98 Fig. 27–28). E. Völling (2008b, 111) argues that in addition to the very light objects, objects that are too heavy should also be eliminated (although without presenting a maximal weight limit).

The ongoing nature of this discussion is hardly surprising, as the range of objects potentially suitable for spinning is enormous. For example, a thread can easily be spun with a potato attached to the spindle stick (Fig. 1). An apple can also be used instead of the whorl, as was done in Tranysylvania a bit more than a hundred years ago and reported by M. von Kimakowicz-Winnicki (1910, 12). K. Schlabow (1976, 37) also speaks of the *»Erleichterung der Drallgebung durch Aufstecken einer Fruchtknolle«*. In addition, the use of bits of pumpkin pushed onto the spindle stick for spinning cotton has been reported from Sudan (Crowfoot 1931, 38). Although many objects can be used, as the above examples show, E. Völling (2008a, 242; Völling 2008b, 107–108) criticises the current practice of referring to all perforated clay objects as spindle whorls without comparing them to such objects that must be regarded with certainty as spindle whorls, such as pictorial sources or *in situ*-finds. This is a justified objection, but it is difficult to implement, as there are very few completely preserved spindles in northern/north-west Germany from the roman iron age, unlike the Ancient Near East, Egypt or the Mediterranean region.

In addition to the fundamental ambiguities just discussed, almost any object can be used as a whorl with the appropriate spinning technique. A meaningful definition of spindle whorls in archaeological contexts should, therefore, be broad enough to acknowledge the wide spectrum of suitable objects. The approach put forward here targets the understanding of archaeologically-identifiable perforated objects that have survived in the context of those spinning techniques in which they could conceivably be used as whorls.

## The functionality of spindle whorls – the relationship between weight and thread (yarn thickness-weight-theory)

There are basically three different spinning techniques, which can be varied according to the person and their needs. The basic principle is to pull out the fibres from the fleece bundle and then twist them together to create a thread. The ends of the raw material must always overlap so that the pulled-out strand does not tear; thus, the individual fibres join together as they twist. The momentum for twisting the wool hairs is provided by a hand spindle, which consists of a spindle whorl (rotational weight) and spindle stick. Spinning with the hanging spindle using the drop spindle technique is probably the best-known and most frequently described spinning technique in literature. One hand turns the spindle while the other holds the fleece bundle, pulling a few fibres out of it that twist together to form a thread. Alternatively, a distaff can be used to hold the fibres. The spinning process is repeated until the spindle has reached the floor, then the yarn produced is wound onto the spindle stick and the process starts all over again. In addition to spinning using the drop spindle technique, it is also possible to spin with the spindle in place (referred to as ›spun with support‹ or ›run in a vessel‹). In this case, the spindle tip runs in a small bowl or on the floor. Unlike the drop spindle technique, the weight of the spindle does not

2 E.g. less than 20 mm: see Crewe 1998, 13; Barber 1991, 51–52 and a weight of less than 10 g: Carington Smith 1992, 674; Crewe 1998, 13.

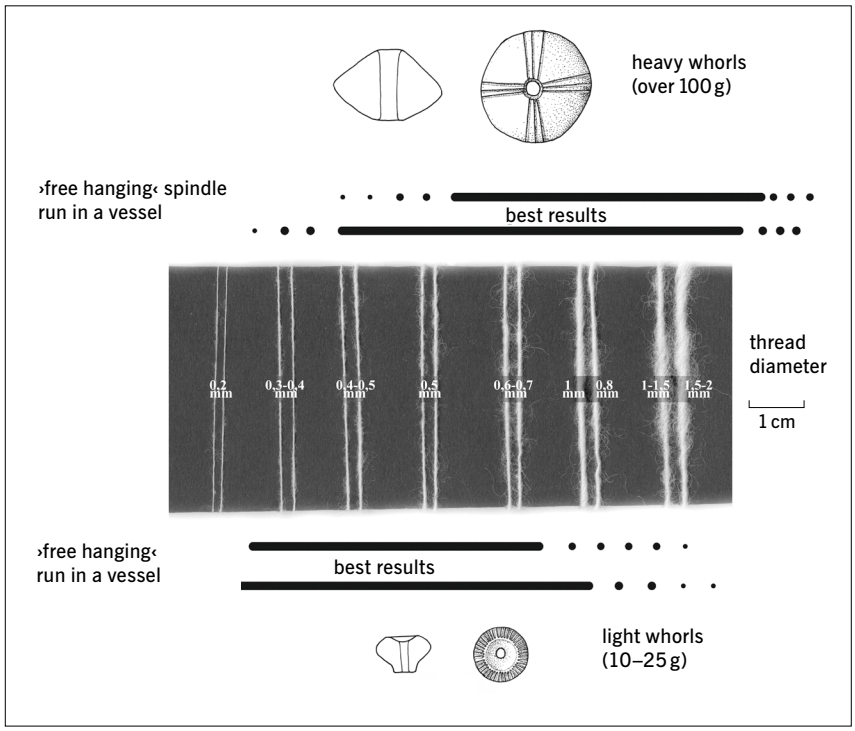



**Fig. 2** Yarn thicknesses produced with different whorl weight classes and spinning techniques.

***Abb. 2*** *Garnstärken, die mit verschiedenen Wirtelgewichtsklassen und Spinntechniken hergestellt wurden.*

pull on the yarn, so its mass plays a less important role. The fleece is held with one hand while the other, the ›spindle hand‹, rotates the spindle and then forms a ›ring‹ with two fingers to give it support, preventing it from tipping over. In contrast to the variant described above, the ›long pull-out‹ is used here. This means that the fibres are not pulled out with the spindle hand, but the fibre hand moves away from the spindle and fibres are pulled out. The twist thus always follows the fibre hand. The third basic method of yarn production is to rotate the stick between the fingers. Here, the lower end is held horizontally and rotated between the fingers without letting go of the spindle. Alternatively, the spindle can also be rolled on the thigh.

To understand how spindle whorls function in practical use, the decisive parameters must first be identified.

Classifications of whorls are repeatedly found in the literature, which states that thin threads can be produced with small, light whorls and coarser threads with heavy, large whorls[3].

Generalised statements regarding whorl weight and thread thickness should be treated with caution, as K. Grömer (2005; Grömer 2010, 90–93 and Fig. 36) shows in spinning experiments. Here, the yarn thicknesses of light (8–25 g) and heavy whorls (over 100 g) were determined both in drop spindle and spun-with-support techniques (Fig. 2). On the one hand, as Fig. 2 illustrates, spindles that are spun with support (i.e. ›run in a vessel‹) produce consistently thinner yarn (both with light and heavy whorls) than those used in the drop spindle technique; on the other hand, the dark lines in the diagram that represent yarn thickness overlap to a relatively large extent for both techniques and both weight classes. In other words, very thin yarns of approx. 0.3 mm thickness can still be produced with heavy whorls when spun with support, whereas yarn diameters > 1.5 mm cannot be achieved with lighter whorls, regardless of the spinning technique applied (Grömer 2005, 115). It has also been stated that finer, as well as coarser yarns, can be produced with every spindle within certain limits (Bohnsack 1981, 59).

In addition, spindle whorls could be removed or attached as required to reduce or add weight. Small whorls, therefore, do not necessarily relate to the production of thin threads but could, instead, have been used as additional weight. It would also be conceivable to reduce the weight if the spindle began to ›wobble‹ due to the accumulated amount of yarn on the spindle stick. The heavy whorl is then exchanged for a lighter one and the spindle rotates better again. Since heavy whorls could also be used to twist two threads and small whorls could have been added or removed as additional weight/weight minimisation, the whorl weight alone can only provide limited information about the yarn thickness produced.

J. Carington Smith (1992, 676) already stated that a heavy whorl does not necessarily produce a thick thread, nor a light one a thin thread. In contrast, thread diameter largely depends on the ability of the spinner, who can influence the thickness of the thread (almost) at will (of course, when using the drop spindle technique, the prerequisite is that the fibres can hold the weight of the spindle). In their spinning experiments, L. Mårtensson et al. (2006a; Mårtensson et al. 2006b) also concluded that the spinning result primarily depended on a person's skill. K. Kania (2013, 24–26) went one step further in her study, stating that the attributes of the yarn produced by one person cannot be predicted, even if another person has already produced yarn under equivalent circumstances (same spindle whorl and fibres).

3 E.g. Koch 1994, 51; Löbert 1982, 66; Mückenberger 2013, 67; Westphalen 1999, 24–25.

| dm. | h. | wt. | MI | |
|---|---|---|---|---|
| 2 | 16.0 | 50.0 | 25.1 | |
| 3 | 3.1 | 21.9 | 24.8 | |
| 4 | 1.0 | 12.6 | 25.1 | |
| 5 | 0.4 | 8.8 | 25.2 | a |

| dm. | h. | wt. | MI | |
|---|---|---|---|---|
| 2 | 8.0 | 25 | 12.5 | |
| 3 | 3.5 | 25 | 28.1 | |
| 4 | 2.0 | 25 | 50.0 | |
| 5 | 1.3 | 25 | 78.1 | b |

**Tab. 1a–b** Almost identical moments of inertia (MI) despite different heights (h [cm]), diameters (dm. [cm]) and weights (wt. [g]) (a) and different moments of inertia despite identical weight (b).

***Tab. 1a–b*** *Beinahe identische Trägheitsmomente (MI) trotz unterschiedlicher Höhen (h [cm]), Durchmesser (dm. [cm]) und Gewichte (wt. [g]) (a) und unterschiedliche Trägheitsmomente trotz identischen Gewichtes (b).*

It is therefore clear that it is difficult to classify spindle whorls in functional categories. This becomes even more obvious when, beyond the technical question of the spinning method applied, additional aspects such as tradition, personal preferences, and a person's skill are considered. The spinning craft offers a wide range of possibilities in which there are no precise technical specifications for thread thicknesses, spinning techniques, weight classes or the like. These variable parameters cannot be made tangible with classifications and categorizations.

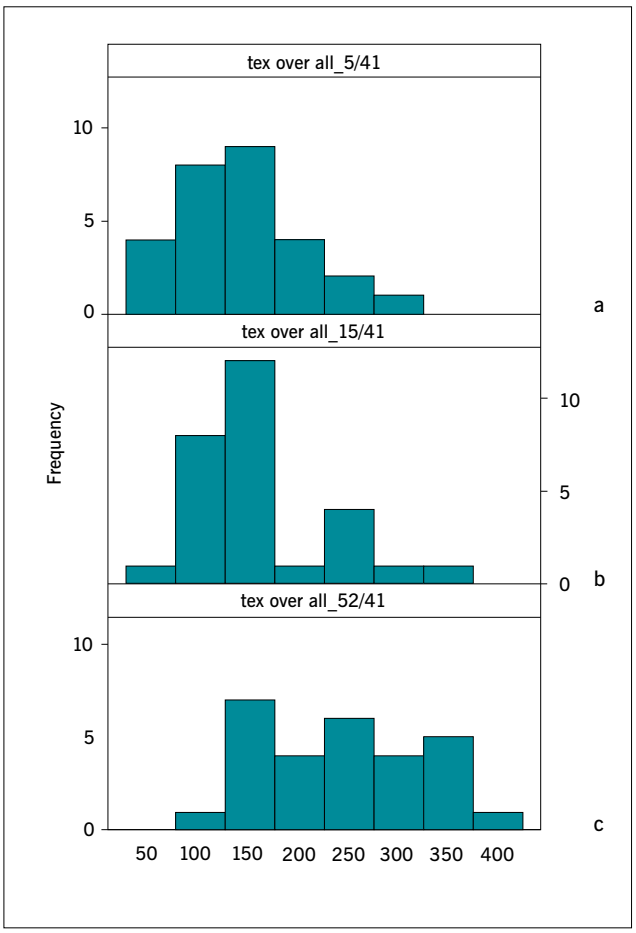



**Fig. 3a–c** Histograms plot the collected sample size (y axis) against tex values of yarns (x-axis: g per 1000 m spun yarn) for whorls of different weight classes and identical MI. a 5 g; b 15 g; c 52 g.

***Abb. 3a–c*** *In den Histogrammen ist die gesammelte Probengröße (y-Achse) gegen die Tex-Werte der Garne (x-Achse: g pro 1000 m gesponnenes Garn) für Wirtel verschiedener Gewichtsklassen mit identischen MI aufgeführt. a 5 g; b 15 g; c 52 g.*

## Functionality of whorl shapes in relation to the spinning technique

So far, the literature on spindle whorls has focussed solely on shape and questions of typology or stratigraphy, while functional aspects of the spindle whorls have been disregarded. As whorls are utilitarian objects that were adapted to the requirements of yarn production, it makes the most sense to combine the shape-based typology with the (inherent) functional properties of the objects.

To better understand the rotational movement of spindle whorls, the Belgian engineer A. Verhecken (2010) studied examples from different areas and periods, including materials from the Viking trading sites of Haithabu, Schleswig-Flensburg District, and Birka, Stockholm County (Sweden) (Andersson 2003), to determine their moments of inertia (MI). The MI refers to the actual state of rest/motion of a body without the effect of an external force. A. Verhecken (2010) found that the rotational properties of a whorl do not primarily depend on its weight (in g), but that diameter (in cm), height (in cm) and mass distribution play an equally significant role, contrary to what is often postulated in the literature (see above). Spindle whorls of almost identical mass may have completely different MI, depending on differences in heights and diameters, i.e. shape variation (Tab. 1b), while whorls with different masses and different heights and diameters can have almost identical inertia (Tab. 1a; Verhecken 2010, 259 Tab. 44.1; 263).

Another study on the functionality of different whorl shapes has been presented by K. Kania (2013; Kania 2015). With her analysis, the author was able to show that neither the different whorl shapes used nor their specific weights would result in the production of yarns of significantly different diameters. This can be seen in the graph (Fig. 3; Kania 2015, 119 Fig. 5): The tex, i.e. yarn weight per length, is measured on the x-axis and the sample size on the y-axis. The tex indicates the weight of the spun yarn in grams per 1000 m length. The results shown are all from spindles with a moment of inertia of 41 and weights of 5, 15, and 52 g. The overlap of tex values between whorl weight classes shows that the thickness of a yarn cannot be easily determined from the whorl used. With these observations, K. Kania (2015, 129) concludes that the spinning result primarily depends on the »human factor« and the spinner's experience, skill and preferences rather than the shape and weight of the whorl.

At the same time, the question arises as to why so many different shapes and weight classes were used if they had

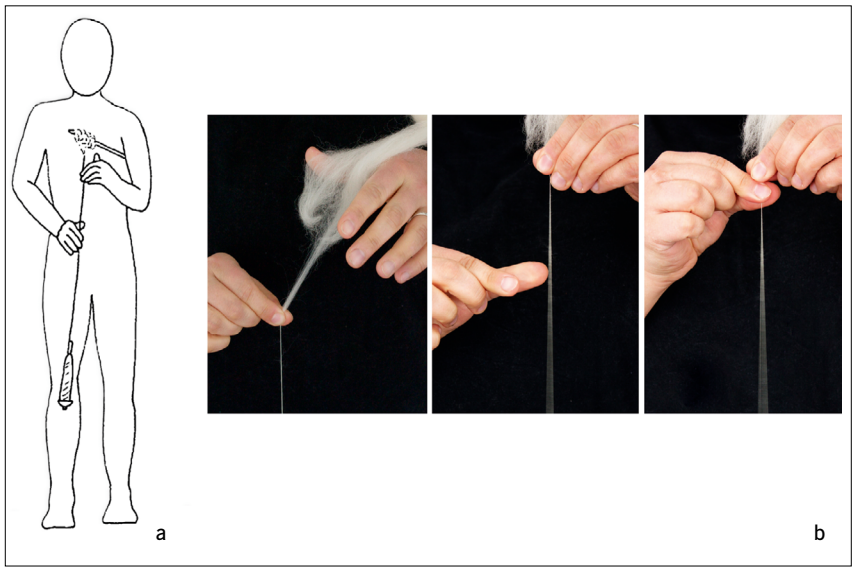



**Fig. 4a–b** Spinning in drop spindle technique with short distaff (a) and illustration of the short draw (b).

***Abb. 4a–b*** *Spinnen in der Fallspindeltechnik mit kurzem Spinnrocken (a) und Illustration des kurzen Auszugs (b).*

no direct effect on yarn diameters. K. Kania offers an explanation for this, observing that whorls with a low MI spin faster than those with a higher one (Kania 2013, 26–27). In addition, K. Kania (2013, 26–27) explains the wide variety of whorl shapes as possible personal preferences. She also mentions that spinning techniques changed »at some point« according to the image sources (Kania 2017, 2–4).

While the urn from Sopron, Győr-Moson-Sopron County (Hungary; approx. 700 BC; Eibner 1986; Grömer 2004, 179), or the rattle plate from Bologna, Emilia-Romagna Region (Italy; approx. 630 BC; Eibner 1986; Grömer 2004, 179), depict spinning using the drop spindle technique (Fig. 4), medieval spinning depictions show a different technique: the fibres are spun in a long draw. One hand – the fibre hand – pulls the fibres out of the tuft, while the spindle hand moves farther and farther from the distaff. The yarn thus stretches diagonally from top to bottom in front of the body. The spindle itself is always guided close below the spindle hand or rotates constantly in the fingers (Fig. 5a). Similar historical depictions can be found, for example, in the ›Psalter of Fécamp‹ (France, around 1180), in a ›Historien Bibel‹ (Germany, late 14th century; Fig. 5b), or in the ›Taymouth Hours‹ (England, 14th century; Fig. 5c). K. Kania (2017, 3) notes that it is often unclear whether the spindle is held just below the hand or in the hand. While the latter method enables a controlled, relatively slow twist in the fleece, spinning with the spindle hanging just below the hand results in a great deal of twist in the yarn. This is because the spindle turns fastest shortly after it is given momentum. By guiding it close to the hand, it can easily be set in motion again. As

**Fig. 5a–c** Spinning in the long draw. a The spindle always remains close to the hand; b depiction from a ›Historien Bibel‹ (Germany, late 14th century); c depiction from the ›Taymouth Hours‹ (England, 14th century).

***Abb. 5a–c*** *Spinnen im langen Auszug. a Die Spindel bleibt immer in der Nähe der Hand; b Darstellung aus einer Historienbibel (Deutschland, spätes 14. Jh.); c Darstellung aus dem Stundenbuch von Taymouth (England, 14. Jh.).*

mentioned above, K. Kania (2013, 26–27) states that whorls with a low MI, i.e. whorls with a mass distribution more centred to the stick, rotate faster than whorls with a high MI and a mass distribution closer to the periphery. Although the former rotate quickly, they do not rotate as long.

Applied to the spinning technique, this means that for the drop spindle technique with a short draw, a whorl is required that rotates for as long as possible as it moves farther and farther away from the hands. The person must bend down to set it in motion again. The spinning technique shown in medieval depictions does not require a long-running whorl, as the spindle runs close to or in the hand and can, therefore, be pushed frequently without any difficulty.

## Spinning techniques from the Roman Iron Age terp village of Feddersen Wierde

Due to the lack of surviving pictorial and written sources, finding evidence for the spinning techniques used at Feddersen Wierde (late 1st century BC to 5th century AD) is difficult, just as at other sites of similar age Central and Northern Europe. However, based on K. Kania's finding (Kania 2013; Kania 2015; Kania 2017) that different shapes and weight classes may possibly relate to different spinning techniques, new possibilities arise. Although experimental archaeology is of great importance for the understanding of functional objects, it should not be forgotten that the results obtained probably do not match the skills and knowledge of the society of the time, whose members had been engaged in the relevant activities from a young age onwards.

Nevertheless, it is important to take a closer look at these finds to better understand how the spindle whorls were used. For this purpose, all accessible finds of the 552 whorls from the terp village Feddersen Wierde were spun and examined for their spinning properties. Excluded are the whorls that could no longer be attached to the stick due to their state of preservation; also excluded were the objects on display in the Museum Burg Bederkesa, Cuxhaven District, and the Küstenmuseum Wilhelmshaven.

### 1 Experimental setup

The aim of the experiment was to determine which whorls are suitable for spinning using the drop spindle technique and which are unsuited to this technique. Five straight, round sticks with different diameters (0.29–0.80 cm), weights (0.8–9.2 g) and lengths (20.0–28.8 cm; Tab. 2) were used as spindle sticks (Fig. 6).

**Fig. 6** The spindle sticks used for the test series sorted by diameter (in mm) from right to left.

***Abb. 6*** *Die für die Testreihe verwendeten Spindelstäbe sortiert nach Durchmesser (in mm) von rechts nach links.*

| Stick | Weight (g) | Diam. (cm) | Length (cm) |
|---|---|---|---|
| 1 | 0.8 | 0.29 | 20.0 |
| 2 | 2.1 | 0.41 | 24.0 |
| 3 | 3.3 | 0.48 | 29.5 |
| 4 | 5.2 | 0.60 | 27.8 |
| 5 | 9.2 | 0.80 | 28.8 |

**Tab 2** Dimensions and weight of the spindle sticks used in the case study.

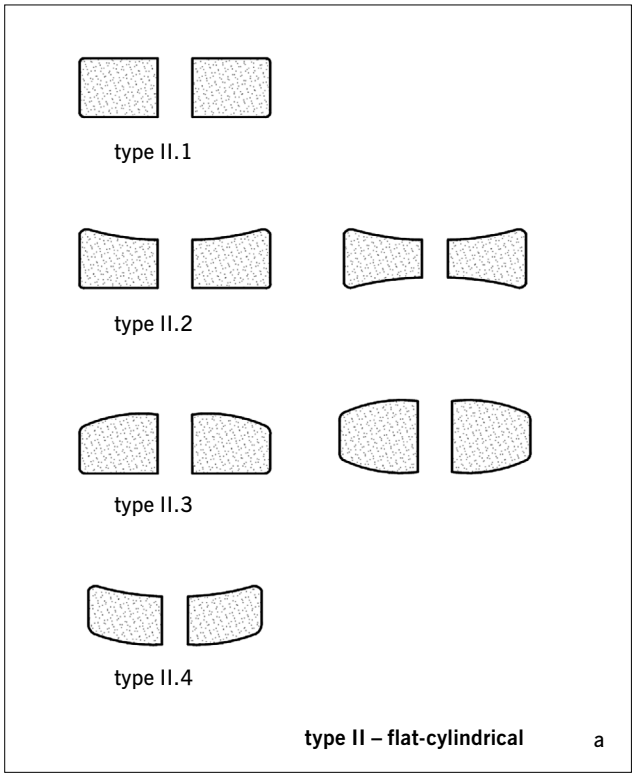
***Tab. 2*** *Abmessungen und Gewichte der in der Fallstudie verwendeten Spindelstäbe.*

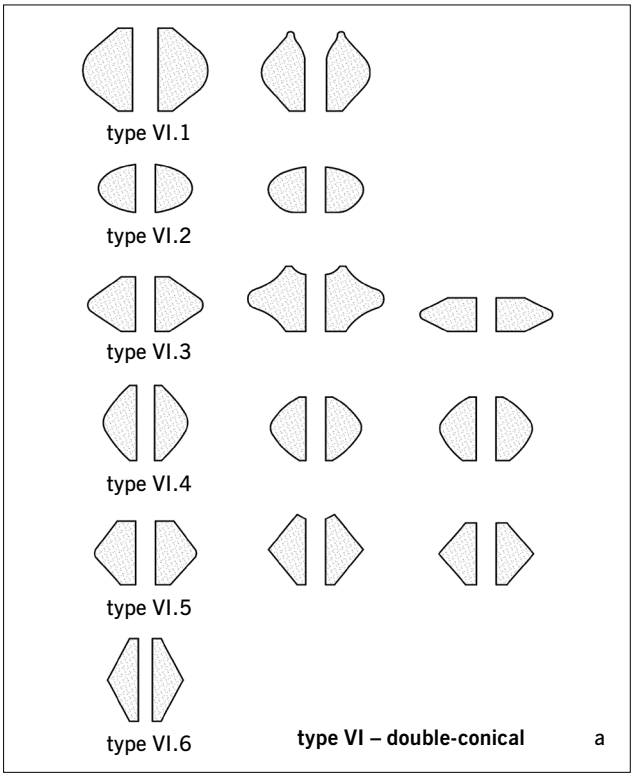
For each experiment, the stick that best matched the holes in the whorl was chosen. The whorls were attached at the lower end and affixed with a thin bubble wrap between the perforation and the stick to ensure a tight fit and prevent further wear. Each whorl was spun at least three times, with the spindle being emptied of yarn after each test so that the yarn did not represent an additional rotational mass and the results

remained comparable. Initially, 1–2 m of yarn was produced, which was not included in the analysis; then the number of times the spindle had to be spun to produce 1 m of yarn was counted. After spinning, spindle whorls were classified as ›short runners‹ or ›long runners‹. Short runners had to be spun at least five times to produce 1 m of yarn. Whorls that could produce 1 m of yarn while being set in motion four times or less were classified as long runners and were, therefore, well suited to spinning using the drop spindle technique. Although ›pushing‹ a spindle four times to produce 1 m of yarn is laborious, as the spindle can only be reached by bending down, the corresponding whorls were (nevertheless) classified as long runners as it can be assumed that the dexterity of the spinners of that era is not comparable to that of most hobby spinners today (Grömer 2004, 179). The spindles were spun with a short draw and the fleece of skudde sheep. In order not to distort the results, the whorls were not sorted according to settlement horizons or subtypes but were chosen at random.

## 2 Observations and interpretation

In addition to the classification of the whorls into long and short runners, other revealing observations were made during the test series regarding the interplay between 1. shape, 2. weight, 3. hole diameter in relation to the spindle stick, 3. central position of the perforation, as well as the spindle stick and fibre material. The relevant factors for the rotational time of a spindle whorl are listed in Tab. 3 and should be understood in descending order.



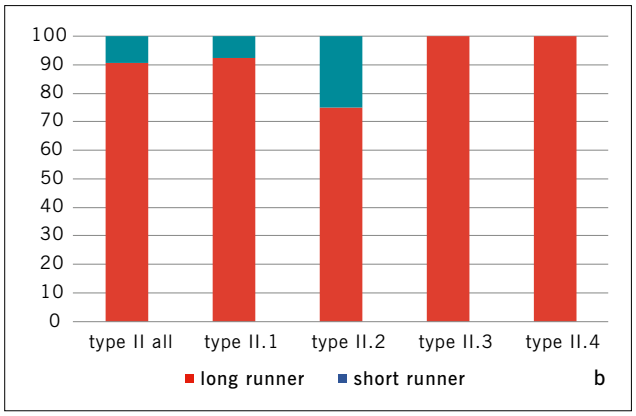



**Fig. 7a–b** Schematic representation of the flat-cylindrical type II without scale (a) and the corresponding distribution of long and short runners (b; n = 21) in percent.

***Abb. 7a–b*** *Schematische Darstellung des flachzylindrischen Typs II ohne Maßstab (a) und die entsprechende Verteilung von Lang- und Kurzdrehern (b; n = 21) in Prozent.*

**Fig. 8a–b** Schematic representation of the double-conical type VI without scale (a) and the corresponding distribution of long and short runners (b; n = 122) in percent.

***Abb. 8a–b*** *Schematische Darstellung des doppelkonischen Typs VI ohne Maßstab (a) und die entsprechende Verteilung von Lang- und Kurzdrehern (b; n = 122) in Prozent.*

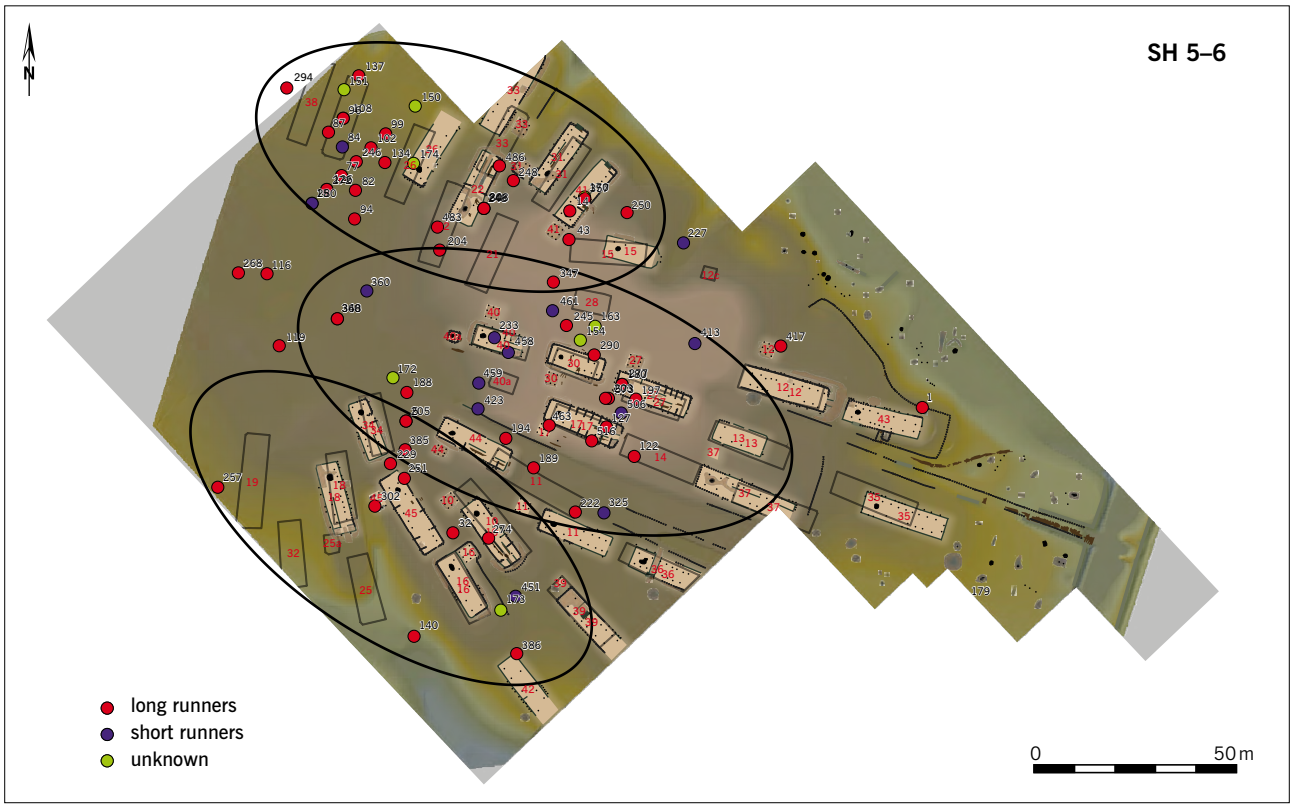



**Fig. 9** Feddersen Wierde, Cuxhaven district. Distribution of short and long runners in the settlement horizons (SH) 5–6 (3rd–4th century AD). In the northern and southern areas there are primarily long runners; in the central area, short and long runners are associated.

***Abb. 9*** *Feddersen Wierde, Lkr. Cuxhaven. Verteilung von Kurz- und Langdrehern in den Siedlungshorizonten (SH) 5–6 (3.–4. Jh. n. Chr.). In den nördlichen und südlichen Bereichen sind Langdreher vorherrschend, während im zentralen Areal Kurz- und Langdreher vergesellschaftet sind.*

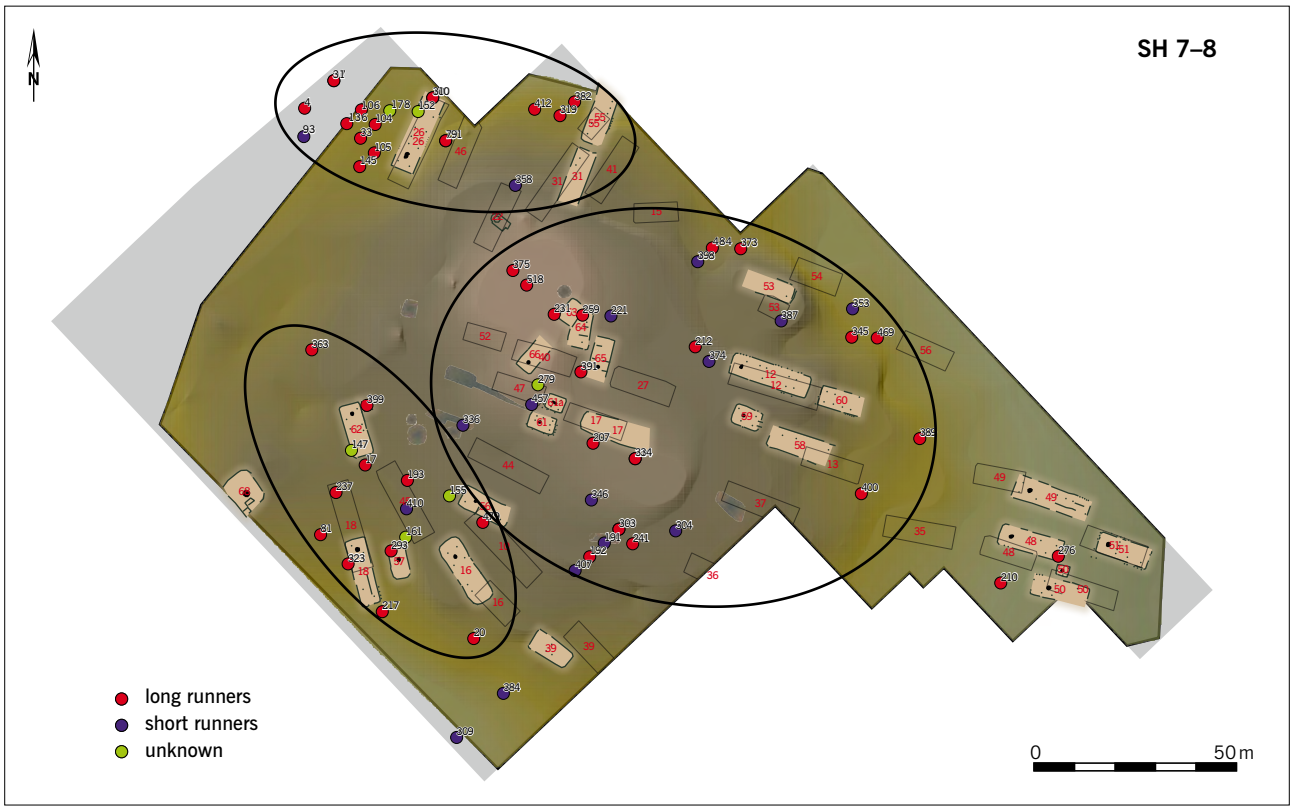



**Fig. 10** Feddersen Wierde, Cuxhaven district. Distribution of short and long runners in settlement horizons (SH) 7–8 (4th–5th century AD). In the northern and southern areas there are primarily long runners, in the central area short and long runners are associated.

***Abb. 10*** *Feddersen Wierde, Lkr. Cuxhaven. Verteilung von Kurz- und Langdreher in den Siedlungshorizonten (SH) 7–8 (4.–5. Jh. n. Chr.). In den nördlichen und südlichen Arealen gibt es vor allem Langdreher, im zentralen Bereich sind Kurz- und Langdreher vergesellschaftet.*

1. The turning time of a whorl depends primarily on its shape. In general, the farther the mass is away from the whorl's centre, the longer it rotates. It should also be noted that a uniform shape is only required for tall, narrow shapes. This means that one can even spin with pottery disks with adjacent corners without any problems.

2. Added to this is the weight: Light whorls are affected more quickly by ›backspin‹ than heavier ones. A small, wide and flat whorl will spin longer than a small, tall and narrow whorl of the same weight but not as long as a heavier whorl with a wide, flat shape.

3. The diameter and centrality of the whorls' perforations also contribute to how long or briefly a spindle rotates. If the perforation takes up a large part of the surface, the whorl will not rotate as long as an almost identical whorl that differs only by a smaller perforation.

3. However, the aspect of the central location of the perforation is only applicable to shapes whose centre of mass is oriented closer to the stick and to small, flat whorls whose centre of mass is located farther out. For a longer rotation time, the latter whorls require a perforation that is as central as possible and runs along the median.

No statements can be made about the effects of the spindle bar and fibre material on the turning time of a whorl, as these factors were not included in the test series.

It is important to note that these statements are only valid when the whorl is fixated at the bottom part of the spindle stick (referred to as a ›foot-heavy‹ spindle) and spun using the drop spindle technique; these statements still must be investigated in relation to other spinning techniques. It must also be emphasised that all these factors are interrelated and should not be considered separately. A generally valid formula cannot be provided, as the whorls are not ideally symmetrical objects, and all three factors can vary greatly depending on the whorl.

## Long- and short-running whorl types

The characteristics of the whorls classified as long- or short runners based on the experimental series can be transferred to the types defined by M. Görlitz (2024). For example, there are whorl shapes that can be classified – primarily or even exclusively – as long- or short-running, such as whorls of flat-cylindrical type II (Fig. 7). Although type II shape whorls tend to rotate long (centre of mass tends to lay in the periphery of the whorl), two objects were assigned to the short runners. This shows that although shape is the main criterion for running time, other factors (see above) also have an effect.

There are also whorl types that comprise both long and short runners, such as the double-conical type VI (Fig. 8). Since short running whorls cannot be spun well using the drop spindle technique, they indicate the use of other spinning techniques.

## Roman Iron Age textile production in north-western Germany: a domestic or a ›professional craft‹?

The long- and short-running whorl types not only provide information about the spinning duration of a spindle whorl and the spinning technique used; their spatial distribution within the settlement area of the Feddersen Wierde also allows contextualisation of these objects within more ›domestic‹ and/or ›professional‹ realms of the terp village. From the 3rd century AD up to the 5th century, the last four settlement horizons (SH) of the settlement area show changing patterns in the spatial distribution of long and short runners. In SH 5–6 (3rd to 4th century AD), three areas can be identified in which primarily long or long/short runners occur. In the northern settlement area, where type I.1 is found, long-running whorls are primarily located. Short running whorls primarily occur in the eastern area of the settlement, where they show a cluster mixed with long-running whorls. In the southern area, on the other hand, primarily long runners are found (Fig. 9). A similar distribution can also be seen in SH 7–8 (4th to 5th century AD; Fig. 10): the clustering of long runners in the northern and southern areas and the short runners mixed with the long-running whorls in the eastern settlement area. The distribution of the long and short runners in SH 5–8 strengthens the observation of an organised domestic trade with different areas of responsibility.

As short-running whorls were probably used in a spinning technique in which the spindle was guided close to the hand, the thread could take up a great deal of twist in a short time; long-running whorls spin longer but do not add as much twist to the yarn. The distribution of long and short runners could be related to the processing of different materials or different staple lengths within the areas. Short-staple fleeces naturally require more twist than longer fibres (Kania 2015, 113). Short-running whorls, therefore, support the requirements of the material. It would also be conceivable to produce warp or weft yarns at different locations. Warp yarns often have more twist than the weft. Strongly twisted yarns in the weft thread, on the other hand, can cause problems if they are not constantly kept under tension (Kania 2017, 4–5). The production of yarns in different thicknesses in different

| | Centre of mass at the edge | Centre of mass centred |
|---|---|---|
| 1. Uniform shape | X | ✓ |
| 2. Weight | ✓ | ✓ |
| 3. Hole diameter | ✓ | ✓ |
| 3. Central location of the perforation | X | ✓ |
| (Rod and fibres) | ? | ? |

**Tab. 3** Factors that are decisive for the rotation duration of whorls with a centre of mass located towards the edge and a centre of mass located towards the middle: ✓ decisive; X no influence; ? unknown.

***Tab. 3*** *Faktoren, die für die Rotationsdauer von Wirteln mit einem zum Rand hin gelegenen Massenschwerpunkt und einem zur Mitte hin gelegenen Massenschwerpunkt entscheidend sind: ✓ entscheidend; X kein Einfluss; ? unbekannt.*

areas could also be considered, as thicker threads require less twist than thinner ones (Kania 2017, 1–2).

The results of the study provided above document the wealth of information that spindle whorls may provide. Wrongfully, this group of finds is often excluded from more in-depth studies. A detailed typology and large-scale, practical test series not only provide insights into ancient craft techniques but also make it possible to understand the organisational structures of the textile craft within a north-western German settlement during the 1st centuries AD.

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# Cloth as human experience: looping, furs, and twining in the Mesolithic of north-west Europe

Susanna Harris and Aris Palyvos

**Zusammenfassung**

Kleidung als menschliche Erfahrung: Schlingen, Felle und Zwirne im Mesolithikum Nordwesteuropas

*Dieser Artikel bietet einen neuen Einblick in kleidungsähnliche Materialien spätmesolithischer Jäger-Sammler-Fischer-Gesellschaften in Nordwesteuropa, indem er archäologische Belege und abgeleitete sensorische Beschreibungen von Personen kombiniert. Kleidungsähnliche Materialien sind flexible, dünne Bahnen, die gewickelt, gefaltet und geformt werden können und das Potenzial haben, Menschen und Dinge zu bedecken. Diese Definition umfasst Stoffe aus verflochtenen Fasern und Tierhäuten. Zu den archäologischen Belegen für mesolithische kleidungsartige Materialien gehören sowohl organische Schlingen- und Zwirngewebe aus Pflanzenfasern als auch archäozoologische Überreste, die auf die Verwendung von Leder und Fellen hinweisen. Die Belege konzentrieren sich auf die späte Ertebølle-Kultur in Südskandinavien (ca. 5400–3950 v. Chr.) in ihrem weiteren geografischen und chronologischen Umfeld.*

*Der zweite Aspekt dieser Arbeit erforscht diese ungewohnten Materialien mit Hilfe einer innovativen Methode. Gruppen von Teilnehmern wurden gebeten, sich physisch mit einem nachgebildeten mesolithischen Kleidungsinventar auseinanderzusetzen und einen Fragebogen auszufüllen, in dem sie gebeten wurden, jedes einzelne Stück anhand seiner Haptik, seines Aussehens, Geruchs und der erzeugten Geräusche zu beschreiben. Philosophisch gesehen basiert dieser Ansatz auf der kulturellen Bedeutung von Empfindung und Wahrnehmung. Die sensorische Beschreibung der Materialtypen durch das Handhabungsexperiment stellt die standardmäßige technische Analyse des Rohmaterials und die Identifizierung der Stoffstruktur in Frage. Sie ermöglicht ein neuartiges Verständnis dieser Materialien, wie sie von Menschen verwendet werden.*

**Schlagwörter** Mesolithikum, stoffartige Materialien, Pflanzenfasern, Tierhäute, sensorisch

**Summary**

*This paper provides a novel insight into cloth-type materials of late Mesolithic hunter-gatherer-fisher societies of North-west Europe by combining archaeological evidence and person-derived sensory descriptions. Cloth-type materials are flexible, thin sheets that can be wrapped, folded, and shaped with the potential to be used to cover people and things. This definition includes fabrics made from interlaced yarns and animal skins. The archaeological evidence preserved for Mesolithic cloth-type materials includes organic looped and twined fabrics made with plant fibre, as well as archaeozoological remains indicating the use of leather and fur. Evidence focuses on the Late Ertebølle culture of southern Scandinavia c. 5400–3950 BC in its wider geographical and chronological setting.*

*The second aspect of this paper explores these unfamiliar materials through an innovative methodology. Groups of participants were asked to physically engage with a replica Mesolithic cloth assemblage and respond to a questionnaire asking them to describe each one according to its texture, appearance, smell, and sound. Philosophically, this approach is based on the cultural significance of sensation and perception. The sensory description of the cloth types through the handling experiment reframes the standard technical analysis of raw material and identification of fabric structure. It provides a novel understanding of these materials as used by people.*

**Keywords** Mesolithic, cloth-type materials, plant fibres, animal skins, sensory

## Introduction

Here, ›cloth‹ refers to the range of flexible, thin sheets of material that can be wrapped, folded, and shaped, with the potential to be used to cover people and things (Harris 2008, 225–227). This focus on cloth-type materials, rather than the technology, brings together cloth made of fibre worked into yarns or strands in a variety of fabric structures with those made of animal skins including leathers (where fur, scales or plumage is removed), and those with fur or other skin appendages such as scales or feathers. In this paper, Stone Age cloth-type materials were identified through archaeological evidence of the Late Mesolithic Ertebølle culture of southern Scandinavia some 7500–6000 years ago, in its wider chronological and geographical setting.

The Late Ertebølle was a stone tool and ceramic using hunter-gatherer-fisher economy. Studies argue these societies had social complexity, shamanism, prestige hunting, and a level of sedentism (summaries in Hellerøe 2023, 2–4; Blankholm 2008). The Ertebølle was chosen as the focus of this research due to exceptionally preserved plant fibre fabrics and zooarchaeological evidence of animals butchered

for their skins, which provide compelling evidence for identifying a late hunter-gatherer cloth assemblage. Following the archaeological evidence, these cloth types were made or sourced to bring together the physical cloth assemblage. Given their unfamiliarity, an innovative sensory handling experiment was developed to collect data on people's experience of late hunter-gatherer cloth types following repeatable methods (Harris 2014; Hamilton/Whitehouse 2006; Hamilton et al. 2020). The combined archaeological evidence and sensory information provide new insights into the cloth assemblage and culture of the Late Ertebølle.

## Sensory worlds

What are the senses? What are the worlds of sense? The senses are bodily ways of perceiving and knowing – at once universal and culturally distinct. In neuroscience, the sensations are separated into vision (sight), audition (hearing), chemosenses (taste/smell), vestibular sensations or proprioception (motion/balance) and somatosensation (touch); the latter is now considered distinct from thermoception (temperature) and nociception (pain) (Fritzsch 2021). Sensations are studied from a spectrum of perspectives: from human universals studied empirically to a human-centred approach focused on sensation and the diversity of perception (Goldstein 2014, 5 Fig. 1,1; Oberman et al. 2010). Classen's social-anthropological study of cross-cultural perspectives on sensation argues for the cultural specificity of sense (Classen 1993, 1–5). Her philosophy of sensation is based on the significance of perception as cultural and learned: senses order culture and express cultual values. The significance of sensation to living beings is immense. Without the nervous system's detection, regulation and response, no thought or action occurs. This is the world of perception that is an ongoing, learned, and interconnected response to the world around us (Merleau-Ponty 2004). These responses provide divergent approaches to cloth; does the body experience comfort, practicality and attractiveness in cloth as a human universal, or are these situated experiences that change over time between groups and individuals?

As archaeologists, sensory information is useful since it allows us to find human connections between cloth and the larger sensory world these materials engender. It provides an avenue into human experience alongside ethnography and recent history (for example, Owen 2005). By producing a sensory description of the cloth through the handling experiment, it is possible to describe the Mesolithic cloth assemblage as a human experience from today's perspective. This moves away from the technical analysis of raw material and fabric structure into the relationship of humans, cloth assemblages and their surrounding world.

## Handling experiment

The ›Mesolithic Cloth Handling Experiment‹ had two parts (see Harris 2014, 39–40). In Part 1, participants chose from different types of cloth and were asked to respond to questions based on their sensory experience of that cloth. These covered the senses of vision (sight), audition (hearing), somatosensation (touch), and chemosensation (smell/taste). For example, is the cloth flat or uneven? Is it shiny or matt? Transparent or dense? Permeable or impermeable? Does it have a weak or strong odour? Participants were asked to state their favourite and least favourite cloth and say why. In Part 2, the participants were asked to work in groups of three or more and order the cloth samples according to a single sensory criterion, such as from the most flexible to the least flexible, the stretchiest to the stiffest, or the noisiest to the least noisy.

Part 1 of the experiment provided the results of people's sensory experience of individual cloth types. Part 2 dealt with the same issues by assemblage. The 57 participants were students and other volunteers living in London, UK. Approximately 7–16 responses were obtained for each cloth type and five groups of comparative responses. Including the introduction and filling out both questionnaires, the handling experiment took two to three hours for each participant. Twenty-first century people cannot comprehend the perceptions of Mesolithic people. However, what is achieved is a ›sensible‹ description of Mesolithic cloth, where sensible means both engaging the senses and being practical. The discussion revisits the question of how these sensory descriptions provide insights into the cloth of late hunter-gatherer societies in north-west Europe.

## Results

The following sections present the archaeological evidence for Late Ertebølle cloth types and the sensory results of the handling experiment.

### Looping

Looping, also called knotless netting or buttonhole stitch, is a fabric structure where a continuous thread is used to create interconnecting loops, which can be joined and twisted in several ways (Seiler-Baldinger 1994, 10–12).

#### *Archaeological evidence*

Looping is preserved in waterlogged contexts at Tybrind Vig, a submerged Ertebølle settlement on the western coast of the island Fyn (Denmark), dated to around 6000 years ago (Bender Jørgensen 2013, 393–395). At Tybrind Vig, there are several types of looping. These include simple looping and looping made with a foundation where an additional yarn runs through the loops. Another type is twisted looping with a foundation (Bender Jørgensen 2013, 393; Seiler-Baldinger 1994, 11). The Tybrind Vig looping was made from tree bast of willow *(Salix)*, possibly also poplar *(Populus)*, and grasses *(Poaceae)* (Bender Jørgensen 2013, Appendix A [U. Körber-Grohne], 401–403).

Looping is also known from other Mesolithic sites. For example, multiple twisted loops at Friesack, Northern Germany, c. 6000 BC, are identified from disconnected loops of plant fibre yarn (Kernchen/Gramsch 1989, 23–25). At Frie-

**Fig. 1** Tree bast was a source of fibre in the Mesolithic. Lime *(Tilia)* bast has a distinctive sharp, sappy, grassy odour that fades with time. Each species of tree bast has a unique colour and odour, which varies according to how it was processed.

***Abb. 1*** *Baumbast war im Mesolithikum eine Quelle für Fasern. Der Lindenbast* (Tilia) *hat einen charakteristischen scharfen, saftigen, grasigen Geruch, der mit der Zeit verblasst. Jede Art von Baumbast hat eine einzigartige Farbe und einen einzigartigen Geruch, der je nach Verarbeitung variiert.*

sack, it is twisted looping. Similar looping was found at Hardinxveld Polderweg in the Netherlands, c. 5500–4500 BC, where their production is associated with bone needles from swan *(ulnae)* (Van Gijn 2012, 277 Fig. 3; Louwe Kooijmans et al. 2001, 401–405). Looping continues into at least the early Neolithic period, with what is probably lime *(Tilia)* tree bast looping discovered at Bolkilde, island of Als (Denmark), c. 3400 BC (Bender Jørgensen 2013, 394; Mannering et al. 2012, 95 Fig. 3.2).

### *Sensory experience*

Three variations of looping were made for the handling experiment using lime tree bast fibre (Fig. 1): simple looping with two-ply yarns (Fig. 2a), single yarns looping with foundation (Fig. 2b) and twisted looping with foundation (Fig. 2c).

When made from lime tree bast, the colour of the looping is reddish yellow to yellow (Munsell 7.5YR 7/6; 10 YR 7/6). Willow tree bast looping has a red to dark reddish-brown colour (Munsell 2.5YR 2.5/4, 5/6). The hue and shade of the looping depend on the natural colours of the different tree species and how it is processed. All three looping variations were described as visibly even to very uneven, with thin to neutral thickness. In terms of sheen, when made with twisted yarn, the looping is matt to neutral. The three looping variations are visibly transparent, and the open loops are physically permeable to air, water, and other substances.

The sound associated with looping made with tree bast fibre is described by the participants as soft, low, crackling, »like rubbing dry grass together«, »leaves rustling«, and »walking through dried grass«. There is a crackly, crispy, crunchy element to rubbing a hand over the surface of this cloth, which is especially noticeable due to the uneven surface.

Tree bast has a strong odour that fades with time. Lime tree bast was described as smelling like wood, dried plant stems, or straw and as smelling sharp, like grass, plants and tree sap. There was a hint of smoke, a fragrance gained by proximity to cooking fires. For one participant, lime tree bast smelt »like summer«. Different species of tree bast fibres have distinctive smells but similar sounds.

To the touch, tree bast looping feels cool or neutral and is rough to very rough. When handled, looping material is flexible to very flexible. The simple looping is very stretchy. Compared with the other cloth-type materials in the assemblage, elasticity is simple looping's most distinctive feature,

**Fig. 2a–c** a Simple looping is the most elastic, permeable cloth in the Mesolithic cloth assemblage. It is rough to the touch, matt, of medium thickness and has a crackling, crunching sound. b Looped cloth with foundation is known from late hunter-gatherer sites in north-west Europe. It is flexible, moderately stretchy, while also stiff. It is permeable and transparent, with texture, smell and sound like simple looping. c Looping with twist and foundation has similar sensory qualities to looping with foundation, except it is more transparent due to the larger spaces created by the additional twist.

***Abb. 2a–c*** *a Ein einfaches Schlingengewebe ist das elastischste, durchlässigste Gewebe der mesolithischen Kleidung. Es fühlt sich rau an, ist matt, von mittlerer Dicke und verursacht ein knisterndes, knirschendes Geräusch. b Schlingengewebe mit Unterlage ist von Fundplätzen später Jäger- und Sammlergruppen in Nordwesteuropa bekannt. Es ist flexibel, mäßig dehnbar, aber auch steif. Es ist durchlässig und transparent, mit einer Textur, einem Geruch und einem Klang wie bei einfachen Schlingen. c Schlingen mit Drehung und Grundierung haben ähnliche sensorische Qualitäten wie Schlingen mit Grundierung, nur dass sie aufgrund der größeren Zwischenräume, die durch die zusätzliche Drehung entstehen, transparenter sind.*

contrasting strongly with the solid, stiff furs and leathers. The looping variations with foundation, while still flexible, are neither overtly stretchy nor stiff. The foundation acts as a stabiliser and prevents the loops from stretching freely. The looping with foundation was rated consistently stiffer and less elastic than the simple looping. The porous and per-

**Fig. 3** Twining technique is known from Mesolithic fish traps. The same technique can be used to make cloth. This open twining made with lime tree bast is flat, medium transparent and matt. It has a rustling and slightly crunching, crackling sound.

***Abb. 3*** *Die Zwirntechnik ist von mesolithischen Fischreusen bekannt. Die gleiche Technik kann auch zur Herstellung von Stoffen verwendet werden. Dieser offene Zwirn aus Lindenbast ist flach, mittelmäßig transparent und matt. Er erzeugt ein raschelndes und leicht knirschendes, knisterndes Geräusch.*

meable quality of all looping variations is another defining feature of this cloth type. The looping with twist and foundation is similar to looping with foundation, except it is a little more transparent and porous due to the larger spaces created by the twist.

The material made by simple looping was appreciated because it was satisfyingly loose and stretchy. Among the participants, there was a general disbelief that this loose, rough, scratchy material would be worn directly on the skin as clothing. Instead, people imagined it for food containers or bags. What such a bag might drain or contain depends on the loop size. Participants were fascinated by the looping in tree bast because it had no immediate modern comparisons. Compared with the other cloth types in the handling experiment, the looped cloth was consistently among the coolest, roughest, noisiest and stretchiest fabrics. Adding the foundation significantly reduces the flexibility of looping and makes the fabric stiffer.

## Twining

Twining is a fabric structure made by connecting a series of parallel aligned strands (called passives) using a pair of twisting elements (called actives) (Seiler-Baldinger 1994, 31). Twining creates fabrics of varying density and flexibility depending on the choice of materials and technique.

### *Archaeological evidence*

Early twined fabric structures in north-west Europe come from fishing traps. These include twined fish traps made with plant materials from the Ertebølle contexts of Nidløse, Zealand (Denmark), several sites in the Netherlands including Bergschenhoek, c. 4200 BC, and Hardinxveld-Giessendam De Bruin, c. 5100 BC (Zaliznyak 1998, 50; IJsveld 2014). At these sites, rigid fish traps will likely be preserved due to their waterlogged contexts. It is plausible that Mesolithic people also made twined cloth using flexible materials. The early Neolithic site of Tulstrup Mose, North Zealand (Denmark), has twining made of lime tree bast (Bender Jørgensen 2013, 395).

Twined cloth appears to be one of the oldest cloth technologies. Twining impressed in clay has been reported at the Palaeolithic site of Pavlov I, Czech Republic (Adovasio et al. 1996, 529–531), dated more than 30 000 years ago (Svoboda et al. 2016, 102). It is likely that the fine twined structure at Pavlov I made with twisted, plied threads would have produced a semi-flexible cloth.

### *Sensory experience*

The twining used for the handling experiment was an open twined structure using lime tree bast strands in the passive elements and lime tree bast cord for the paired active

elements (Fig. 3). As it is made from lime tree bast, the colour and smell were described similarly to the looping. The visual aspects of the open twining produced mixed results. For some participants, it was seen as flat; for others, neutral or uneven and somewhat dense, while also slightly transparent due to the small gaps between the strands. Overall, twining was rated as matt. The sound made when a hand was rubbed over the cloth or when the cloth was rubbed on itself was described as »rustling and slightly crunching«, »crackling«, »scratchy«, »like a brush sweeping«, »dry«, »rustling« and »a creaky rustle«. The texture was described as somewhere between soft and rough. To the touch, it was cool to neutral. The twining is fairly thin, porous, flexible, and a little stretchy while also stiff.

Compared with the other cloth types in the assemblage, the twining is rated as average or medium for visual evenness, sheen, odour, roughness, thickness, porosity, and permeability. The open twining has distinctive sounds and flexibility. It was rated by several groups as the noisiest and most inflexible cloth and one of the coolest fabrics to the touch.

## Leather and fur

Leather is made from animal skins and is here used to define those skins where the fur, hair, scales or plumage is removed, in contrast to those skins where the coat (fur, hair, scales, feather) is left intact.

### *Archaeological evidence*

In the absence of preserved Mesolithic furs and leathers, their presence is investigated through zooarchaeological evidence. The full range of animals butchered at a site – whether mammals, fish or birds – had a skin; all can be processed into cloth. A range of animals was butchered at Late Ertebølle sites in Denmark, including those with striking furs. For example, the Ringkloster seasonal hunting camp, eastern Jutland (Denmark), the Tybrind Vig habitation site, and the Agernæs specialist fur procurement site, North Funen (Denmark), have archaeozoological evidence: that includes red deer *(Cervus elaphus)*, auroch *(Bos primigenus)*, roe deer *(Capreolus capreolus)*, brown bear *(Ursus arctos)*, pine marten *(Martes martes)*, polecat *(Mustela putorius)*, wolf *(Canis lupus)*, fox *(Vulpes vulpes)*, domestic dog *(Canis familiaris)*, lynx *(Lynx lynx)*, wild cat *(Felis silvestris)*, otter *(Lutra lutra)*, badger *(Meles meles)* and beaver *(Castor fiber)* (Rowley-Conwy 1994, 88 Fig. 1; Trolle-Lassen 1986; Richter 2005). The high proportion of foetal or newborn roe and red deer skeletal remains at Ringkloster suggests they could have been exploited for the specific physical properties of their young skins or distinctive speckled hides (Rowley-Conwy 1994, 94–95). Given the importance of cloth-type materials in human material culture assemblages, an underlying assumption is that the skins of all butchered animals were used in one way or another.

Cut marks on the extremities of animal carcasses are associated with skinning, partly to preserve the full extent of the skin, and hint at an interest in the hide or fur (Charles 1997, 259). Historically, certain species were appreciated for their attractive furs or plumage and seem to have been targeted in the Mesolithic. The Ringkloster pine marten skeletons have cut marks on the skull and mandible associated with skinning, indicating the removal of the pine marten's distinctive dark brown fur with a white bib. They were found in large quantities with fully articulated skeletons, suggesting that, although skinned, they were not exploited for meat (Andersen 1994, 49; Rowley-Conwy 1994, 95–96). Similar pine martin bone assemblages are found at Agernæs, where the pine martens have burnt teeth; this may suggest they were trapped by thrusting burning sticks into their dens (or burrows they occupied) to draw them out, thus maintaining an intact coat (Richter 2005, Fig. 3).

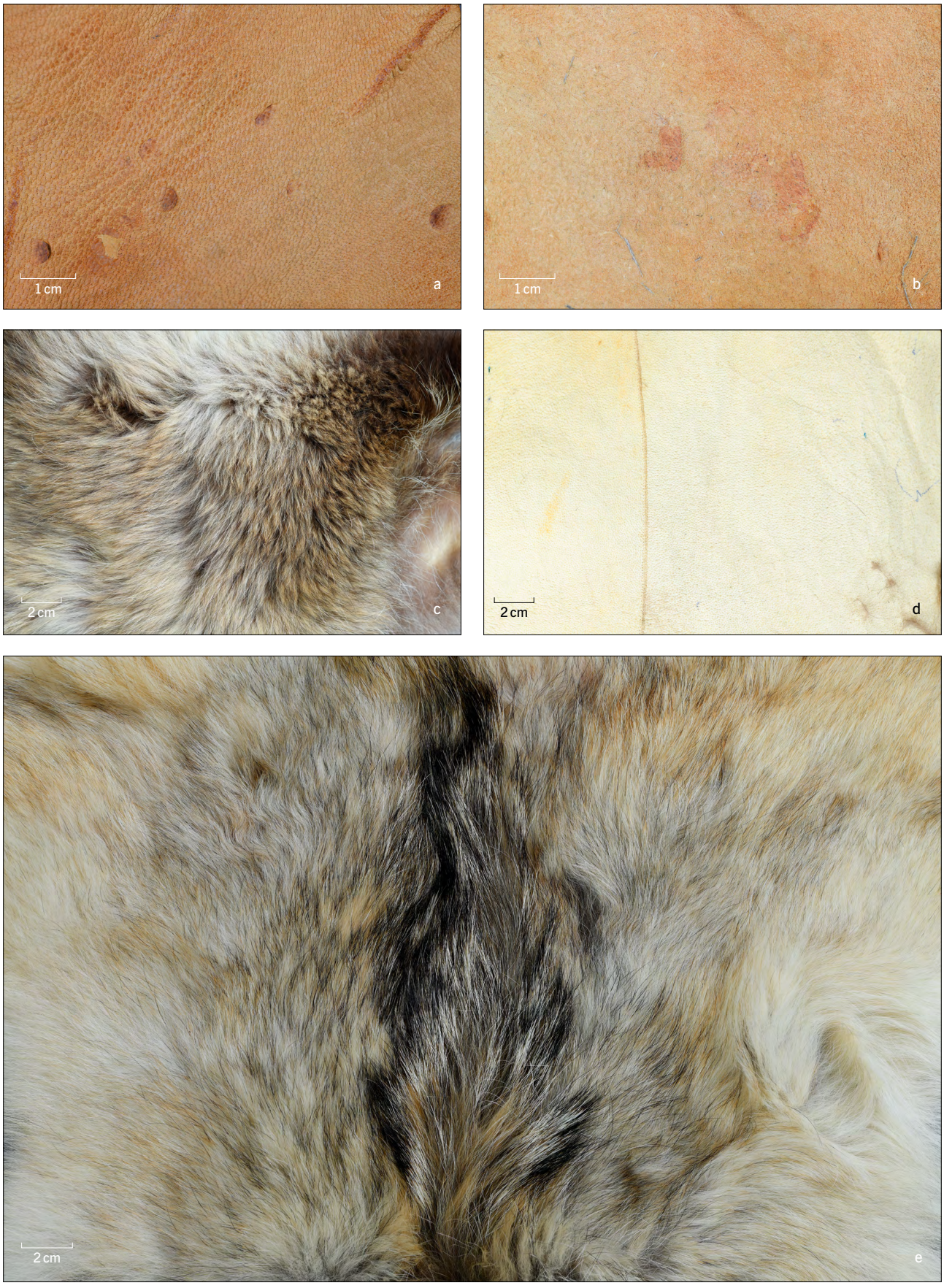
It is not only mammals that have attractive and useful skins. The Late Mesolithic Ertebølle site Aggersund in North Jutland (Denmark) is interpreted as a kill site for swans, a potential source of feather plumage and down (Blankholm 2008, 118). Bird skins with down and feathers are becoming better appreciated as cloth-type materials due to new methods for their detection (Kirkinen et al. 2022, 7). The survival of keratin fibres (animal hair, feathers) at a Mesolithic child's burial at Majoonsuo, Outokumpu (eastern Finland), 7521–7337 cal. BC (Ua-64385, 8354 ± 37 BP), indicates that the grave was furnished with waterfowl down *(Anseriformes)* (Kirkinen et al. 2022, 9; 13). Fish skins, especially those of salmon, eel, shark, catfish and burbot, are an underappreciated source of leather (Rahme/Hartman 2001, 42) and are still to be detected archaeologically.

### *Sensory experience*

Fat-tanned deer leather has two distinct faces, the grain side (outward facing) and the flesh side (Fig. 4a–b). Deer leather is reddish to brownish yellow (Munsell 7.5YR 6/8; 10YR 7/8, 6/8). The grain side is visually flat, shiny and very dense. The flesh side has the same features, except it is visually matt. Both sides are soft to the touch and not especially cool or warm, although the grain side is somewhat cooler to the touch than the warmer flesh side. People likened the smell to tanning products, a shoemaker's shop, a »warm smell«, »like a leather jacket«. This was a familiar odour described

**Fig. 4a–e (right page)** a Furs and skins were an important source of cloth for hunter-gatherer societies. Deerskin leather, grain side, is thin and very flexible, with a flat, smooth surface. b Deerskin leather, flesh side, has a rough and slightly sandy texture when compared to the smooth, grain side. c Red fox, fur side *(Vulpes vulpes)*, is pale yellow to yellowish brown and light red. The fur is a mix of flat and uneven areas that are shiny and very dense. To the touch, fox fur is very soft. d Red fox, flesh side, has a flat, slightly rough surface, which contrasts to the fur side. e Silver fox fur *(Vulpes vulpes)* is variegated from white to pinkish white, very pale brown to black. The odour is described as smelling like a dog, like a fur coat or musky.

***Abb. 4a–e (rechte Seite)*** *a Felle und Häute waren für Jäger- und Sammlergesellschaften eine wichtige Quelle für Kleidung. Hirschleder, Narbenseite, ist dünn und sehr flexibel, mit einer flachen, glatten Oberfläche. b Hirschleder, Fleischseite, hat im Vergleich zur glatten Narbenseite eine raue und leicht sandige Textur. c Rotfuchs, Fellseite* (Vulpes vulpes), *ist blassgelb bis gelblich-braun und hellrot. Das Fell hat eine Mischung aus flachen und unebenen Bereichen, die glänzend und sehr dicht sind. Bei Berührung ist das Fell des Fuchses sehr weich. d Rotfuchs. Die Fleischseite hat eine flache, leicht raue Oberfläche, die im Kontrast zur Fellseite steht. e Das Fell des Silberfuchses* (Vulpes vulpes) *ist weiß bis rosa-weiß, sehr blassbraun bis schwarz gefärbt. Der Geruch wird als hundeähnlich, pelzartig oder moschusartig beschrieben.*




as »just normal leather smell«, »it is a friendly sort of cloth«. The sound made by the material was described as slight scuffing, smooth without an abrupt cut-off, brushing, muffled, whispered, almost soundless, very soft, slightly different on each side, »the outside a little sandy«, »sounds like walking on a carpet«, »like wind blowing«. In terms of

touch, the leather is impermeable, very flexible, somewhat stretchy and neither especially thick nor thin. When compared with the rest of the cloth assemblage, the deerskin is notably thin and very flexible, with the flattest, smoothest surface.

Three furs were examined as part of the handling experiment: red fox, and silver fox *(Vulpes)*, bear *(Ursus)* (Fig. 4c–e). The silver fox is a less common colouration. Like leather, the furs have two distinct faces: the fur side and the flesh side.

The silver fox fur is variegated from white to pinkish white, very pale brown, and light greenish grey to black (Munsell 10YR 8/3, 2.5YR 8/1, 5YR 8/1-2, 7.5, Gley 1 8/10Y, YR 2.5/1). The red fox fur is very pale to pale brown, yellowish brown, pale yellow, and light red (Munsell 10YR 8/2, 10YR 5/4. 2.5 YR 6/6, 2.5Y 8/3, 5Y 8/2). The bear fur is dark brown, however the colouration of the bear fur in the experiment was discounted as it has changed due to the way it was tanned. The fur side of both foxes is perceived as both flat and uneven, shiny and very dense.

The fox has a strong odour. It is described as smelling like a dog, like a fur coat, musky, like warm fur or hair, reminiscent of animal fat or dry wool. The smell of the bear fur was described in a similar way. Regarding fox, a student who was also a farmer answering the questionnaire said he immediately »smelt the predator«.

To the touch, the fox and bear furs are very soft; participants initially rated them as »neutral to warm«, but this changed to »warm« when the dark furs heated up in the sun. When handled, fur seems impermeable, is very flexible, stiff to neutral, and thick to very thick. The flesh side varied between flat, matt and rough.

Compared to the cloth assemblage, the furs and the grain side of the leather are the shiniest, smoothest and most impermeable. The furs are the thickest cloth types and have the least sound. They are moderately flexible and stiff. Their odour is noticeable, especially the furs. Mostly, people were unfamiliar with the smell of the different animals and likened them to more familiar domesticated species, especially pets. The colour of each coat is varied and was appreciated for its decorative nature. The stretchiness of the soft deer leather was seen positively. The bear fur was noted for its potential rarity and striking dark colour. The fox fur was especially appreciated as a soft, fine fur, described as »like stroking a dog«. People thought it would be ideal as a hood edging or other decorative feature because »it's cute«. However, the smell of the fox was polarising – to some, it »smelt bad«, while to others, it »smelt nice«. The furs also elicited negative reactions because of what is perceived as an unnecessary death – a perception based in twenty-first-century ethical considerations of animal welfare. This is a reminder of the non-material considerations people make about cloth and the issue of cultural taboos.

## Sensory cloth worlds of late hunter-gatherer

What does this say about late hunter-gatherer cloth assemblages? Archaeological evidence points to a varied world of cloth. Plants processed to make fibres and yarns were made into looping and twined fabrics that could be adjusted in numerous ways. A supply of animal skins was gained by hunting mammals, birds and possibly fish. There was an interest in specific fur-bearing mammals, notably pine martens, with people killing and skinning them at specialist hunting sites. We are only just starting to understand the role of bird skins with plumage as cloth, which adds a swathe of materials to the late hunter-gatherer cloth assemblage. The killing of neonate deer may suggest the desire for especially fine, soft skins (L. Janik, pers. comm). Investigating the archaeological evidence for Late Ertebølle cloth in its wider geographical and chronological setting shows that there was an extensive repertoire of cloth-type materials.

The sensory results of the handling experiment provide novel insights into the physical and sensory qualities of the materials in relation to the human body. Because of their proximity to the body, we may assume cultural attitudes to practicality and comfort played an important role.

There is a noticeable contrast between the nearly silent animal leathers and furs and the crackly, crunchy plant fibre fabrics. This calls attention to the tasks of Late Ertebølle life: for trackers and hunters, moving silently in the world would be a benefit. Mammal furs and bird feathers are not simply source of food, as clothing their skins and pelage provide colour, pattern, texture and decorative potential. The lustrous sheen, the recognisable coat of each species, and even the lingering animal odours draw attention to the potential of what may be called the prestige of certain furs, especially when worn as clothing. Warmth, thickness and the impermeability of furs have long been assumed to be part of their appeal in northern latitudes and are aspects of how furs differ from plant fabrics. We add to this that dark-coloured furs like pine marten, bear, and beaver become warmer to the touch in the sun. The sensory results draw attention to the ways furs contain the smell of the animal and how smell, most of all the senses, is attached to memories of previous sensory encounters. Did the smell of a bearskin cloak elicit adrenalin and fear, as well as awe? Was the fox or pine marten scent prized or ignored? The underside of the leather and furs feels a little grainy, while the grain side of the leather is pleasantly smooth. At the Tybrind Vig habitation site, people decorated wooden oars (Andersen 2013); it is not difficult to imagine people carefully stitching garments to capture attractive designs.

The plant fibre fabrics rustle, crackle and smell according to their origins. Twining for fish traps is rigid basketry rather than cloth yet utilises the permeable and solid qualities of open twining. As flexible cloth, twining's medium flatness, flexibility, porosity and density suggest a versatile cloth. The spaces in twined fabrics are both permeable and a way to trap air; when layered with other fabrics this may act as insulation. In contrast, twining lacks the attractive gloss, smoothness, and texture of fur yet provides a simply constructed solid, stable, flexible fabric. Looping from plant fibres is a distinctive type of cloth. The looped open structure seems more suitable for containers than clothing. The elastic, open looping fabric would be ideal for carrying fish, seaweed, tubers, or other items where it would be beneficial to allow water, sand, or soil to drain away when they were carried or stored. It is harder to imagine this looped fabric as clothing. Yet, archaeologists will do well to remember that

we only see part of the cloth assemblage. The looped structure made of fine gut, sinew, or strips of hide could have been used creatively to elasticate garments.

The sensory experiences are a reminder of the interconnection between cloth and clothing and the Late Mesolithic culture, environment and task scape. As people wore clothes, so they appeared and smelled like the plants and animals they interacted with in other ways. For example, how did the feeling of winter fur clothing, or the distinctive smell and sounds of twined clothing, find connection with the plants people collected and processed, the animals they tracked, or the beings encountered in shamanistic rituals?

The cloth types are identified here through archaeological evidence, but also those less easily identified in the archaeological record were integral to the physical and sensory world of the Late Ertebølle hunter-gatherer-fishers. Their identification provides a basis for understanding the cloth and clothing people used and wore. The sensory experiences provide glimpses into the world of cloth and the people of these societies. They honour the cycle of daily interactions with plants and animals. People wore clothes that were planned and prepared, that rustled and smelt, and that could be stretchy, warm, smooth, red, white, yellow, brown, shiny, or matt. From the experimental results, we understand that the sensory experience of cloth among late hunter-gatherer-fishers of Late Mesolithic Scandinavia characterise a distinctive sensory cloth world, different from that to which we are accustomed. The lingering scent of animals, the prickle of plant fibres on the skin, or the non-breathability of fur clothing can be challenging to modern sensibilities. Cloth experiences of the past are based on culturally attuned sensations of comfort and practicality that may not be intuitive to us today (Harris 2019, 224). In the absence of preserved intact garments, the human experience of replicated Mesolithic cloth is one way to add depth and enquiry to the knowledge of clothing people made and wore in late hunter-gatherer societies.

## Acknowledgements

Thanks to all those who participated in the handling experiments, which were carried out as part of a British Academy Postdoctoral Fellowship. I am grateful to Dene Wright and William Broom for sharing reading and ideas and to Pippa White for proofreading. Following the CRediT (Contributor Roles Taxonomy) conceptualisation, methodology, analysis and writing by Susanna Harris, visualisation by Aris Palyvos, University of Glasgow. For the purpose of open access, the author(s) has applied a Creative Commons Attribution (open access under CC BY-NC-ND) licence to any Author Accepted Manuscript version arising from this submission.

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# SEKTION V: KLEIDUNG UND KÖRPERSCHMUCK: FALLBEISPIELE

# SECTION V: CLOTHING AND BODY ORNAMENTATION: SOME EXAMPLES

Die gravierte Schieferplatte zeigt kopflose, anthropomorphe und mit Mustern gefüllte Darstellungen vom Gönnersdorf-Typ. Gönnersdorf, Lkr. Neuwied (Foto: Volker Iserhardt, LEIZA; nach Jöris 2021, Gaudzinski-Windheuser/Jöris 2015; vgl. Bosinski u. a. 2001, Objekt Nr. 87, die sogenannten »Strickvenüsse«).

*The engraved shist plaquette shows headless, anthropomorphic depictions of Gönnersdorf-type, filled with hatched and cross-hatched patterns. Gönnersdorf, Neuwied District (Photo: Volker Iserhardt, LEIZA; after Jöris 2021; Gaudzinski-Windheuser/Jöris 2015; cf. Bosinski et al. 2001, plaquette no. 87, the so called »Strickvenüsse«).*

# Fashion trends and body ornamentation in the Upper Palaeolithic of southwestern Germany

Sibylle Wolf and Nicholas J. Conard

**Zusammenfassung**

Modetrends und Körperschmuck im Jungpaläolithikum Südwestdeutschlands

*Das Jungpaläolithikum in Südwestdeutschland wird zwischen 42 000 und 12 000 vor heute datiert. Die drei übergreifenden Kulturphasen sind das Aurignacien (42 000 bis 35 000 Jahre vor heute), das Gravettien (35 000 bis 30 000 Jahre vor heute) und das Magdalénien (17 000 bis 14 000 Jahre vor heute). Die Fundstellen, die vor den Beginn des letzten glazialen Maximums (LGM) datieren, sind vor allem auf die Schwäbische Alb konzentriert. Jede der erwähnten Kulturphasen zeichnet sich durch die Fertigung von andersartigen persönlichen Schmuckelementen aus. Im Aurignacien sind die archäologischen Inventare von doppelt durchlochten Perlen aus Mammutelfenbein geprägt. Trotzdem gibt es schon in dieser frühen Phase des* Homo sapiens *in Mitteleuropa Perlentypen, welche auf Modetrends und die Existenz von besonders beliebten Formen hindeuten. Die Jäger-Sammler-Gruppen des Gravettien bevorzugten tropfenförmige Perlen aus Mammutelfenbein, während nach dem letzten glazialen Maximum Schmuck mehrheitlich aus Gagat und Muscheln gefertigt wurde. In allen Perioden nutzten die Menschen durchlochte Karnivoren-Zähne als Schmuckstücke.*

*Auch bei der Herstellung der für die jeweiligen Kulturphasen typischen Artefakte, wie Lochstäbe und Geschossspitzen, lässt sich ein Wechsel der bevorzugten Rohmaterialien beobachten. Während des Aurignaciens wurden mehrfach durchlochte Elfenbeinstäbe wohl zur Herstellung von Seilen aus Pflanzenfasern verwendet. Pflanzenfasern waren auch für die Herstellung von Kleidung wichtig. In den nachfolgenden Perioden wurden Lochstäbe aus Rentiergeweih verwendet und ihre Formen veränderten sich. Zu Beginn des Jungpaläolithikums wurden spitze Werkzeuge wie Ahlen aus Mammutelfenbein und Knochen hergestellt, während im Gravettien Ahlen aus Knochen verwendet wurden. Im Magdalénien sind Nähnadeln aus Knochen besonders oft belegt, ebenso wie ein Knopf. Daraus kann geschlossen werden, dass die Menschen damals genähte Kleidung trugen, und generell gut gekleidet waren.*

*Die figürlichen Kunstwerke sind eine Besonderheit des Schwäbischen Aurignaciens. Die Frauenstatuette aus Elfenbein aus der Höhle Hohle Fels bei Schelklingen, Alb-Donau-Kreis, gilt weltweit als eines der ältesten figürlichen Kunstwerke. Sie weist am ganzen Körper tiefe und bewusst platzierte Ritzungen auf. Das Fragment einer zweiten Statuette stammt ebenfalls aus dem Hohle Fels, und weitere Darstellungen von Menschen oder Mischwesen aus Mensch und Tier wurden aus diversen Fundstellen der Schwäbischen Alb ausgegraben. Alle Objekte weisen Verzierungen und Ritzungen*

**Summary**

*The Upper Palaeolithic of southwestern Germany dates from 42 000 to 12 000 cal BP. The three major cultural phases were the Aurignacian (42 000 to 35 000 cal BP), the Gravettian (35 000 to 30 000 cal BP) and the Magdalenian (17 000 to 14 000 cal BP), the latter two separated by the Last Glacial Maximum (LGM). Sites preceding the LGM are concentrated in the Swabian Jura. Each specific cultural phase delivered characteristic personal ornaments. Double-perforated beads made from mammoth ivory dominate the archaeological inventories of the Aurignacian. Nevertheless, even from this early phase of* Homo sapiens's *presence in Central Europe, we know of bead types that hint at fashion trends and stylistic choices. During the Gravettian, the hunter-gatherers typically made tear-drop-shaped beads from mammoth ivory. After the LGM, the choice of raw material for carving personal ornaments changed to mainly jet and molluscs. During all periods, people used perforated carnivore teeth.*

*We also observe shifts in raw material choices for producing other characteristic artefacts of the respective periods, including perforated batons and pointed tools. During the Aurignacian, perforated batons with multiple holes, made from ivory, may have been used for making ropes from plant fibres. Fibres may have been important for producing clothes. In the subsequent periods, craftspeople used perforated batons in different shapes made from reindeer antler. At the beginning of the Upper Palaeolithic, pointed tools like awls were made from mammoth ivory and bone; during the Gravettian, people used awls made from bone; and during the Magdalenian, bone sewing needles with eyelets were frequently used. Even a button is known. All this means that people sewed clothes and dressed well.*

*Aurignacian figurative artworks are a speciality of the Swabian Jura. The female figurine from Hohle Fels Cave near Schelklingen, Alb-Donau-Kreis District, is made from ivory and counts amongst the oldest artworks worldwide. The entire body bears deep and deliberately placed incisions. A fragment of a second figurine was also found at the site, and human and human-animal figurines have been discovered at other sites in the Swabian Jura. All the artworks bear decorations and incisions. These incisions may well depict clothes, tattoos or body painting. The finds provide important clues as to the appearance of our ancestors.*

**Keywords** Upper Palaeolithic, southwestern Germany, personal ornaments, figurative artworks

*auf. Diese werden als Kleidungsstücke, Tätowierungen oder Körperbemalungen interpretiert. Die Funde geben Hinweise auf das Aussehen unserer Vorfahren*

**Schlagwörter** Jungpaläolithikum, Südwestdeutschland, persönlicher Schmuck, figürliche Kunstwerke

## Introduction

Personal ornaments are a frequent subject of research in Palaeolithic archaeology. M. Haidle (2003) argues that ornamentation serves primarily as a means of communication, and objects are perceived as decorative and ornamental in a subjective way. When such objects are worn on the body and presented to the environment, either sewn on clothing or used as jewellery, they may reflect an expression of a person's individuality. For the individual and within a group, personal ornaments can be arranged in a specific manner to convey a special meaning. Such displays can then be perceived, interpreted and understood by the others. The purpose of wearing the pieces is multifaceted[1]. Personal ornaments are used to express diverse conventions or to distinguish an individual from a group. Alternatively, personal ornaments can help to integrate individuals within their social context. The wearing of ornaments thus always creates meaning (Kehnel 2011). Prehistorians, for example, can use these artefacts to argue for the existence of cultural units within the European Early Upper Palaeolithic (Vanhaeren/d'Errico 2006; Baker et al. 2024) and to demonstrate vast social networks, evidenced by the distribution and use of carefully selected, specialised beads (Stiner 2014). Body

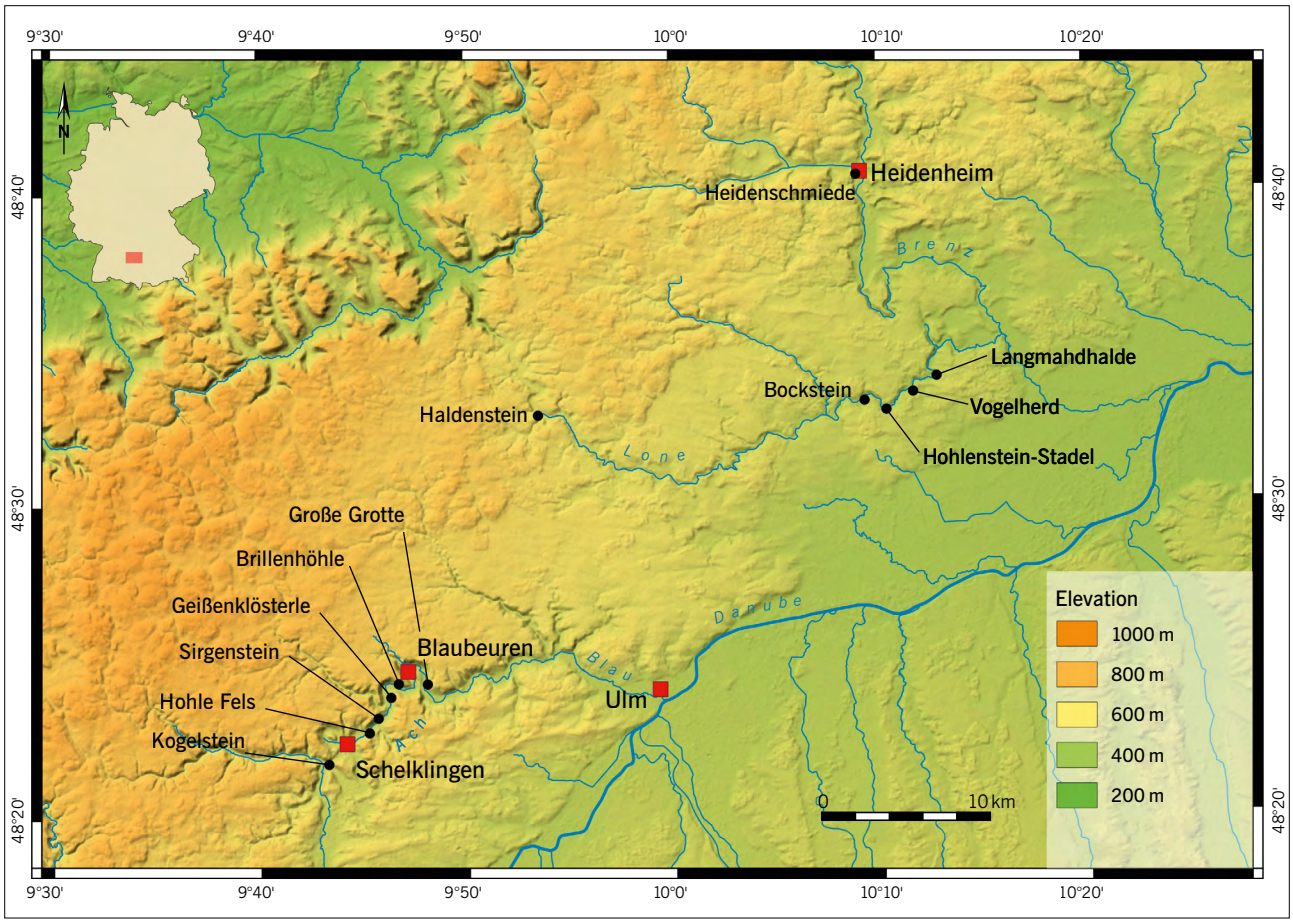


**Fig. 1** Map of the Swabian Jura (Southwest Germany, Ach-, Brenz- and Lone Valleys) with major sites that yielded prehistoric remains. Four sites provided Aurignacian figurative art: 1 Vogelherd Cave, Heidenheim District; 2 Hohlenstein-Stadel, Alb-Donau-Kreis District; 3 Geißenklösterle, Alb-Donau-Kreis District; 4 Hohle Fels, Alb-Donau-Kreis District.

***Abb. 1*** *Karte der Schwäbischen Alb (Südwestdeutschland, Ach-, Brenz- und Lonetal) mit den wichtigsten Fundstellen prähistorischer Funde. Vier Fundorte lieferten figürliche Kunst aus dem Aurignacien: 1 Vogelherdhöhle, Lkr. Heidenheim; 2 Hohlenstein-Stadel, Alb-Donau-Kreis; 3 Geißenklösterle, Alb-Donau-Kreis; 4 Hohle Fels, Alb-Donau-Kreis.*

1 Kuntzsch 1978; Hauser-Schäublin 1988; Morris 1994; Lock/Symes 1999; Vanhaeren 2010.

**Fig. 2** Hohle Fels. Excavation 2022.

***Abb. 2*** *Hohle Fels. Ausgrabungssituation 2022.*

ornamentation can be interpreted as a medium or technology for communication and a testament to social interaction (Kuhn/Stiner 2007). Over recent decades, numerous studies have examined the form, function, and standardisation of prehistoric beads (e.g. Heckel 2015), as well as their diverse meanings[2].

## Material

The Palaeolithic ornament assemblages of the Swabian Jura sites comprise objects made from mammoth ivory, animal teeth, molluscs, soapstone, jet, and fossils (Conard 2003a). The Upper Palaeolithic of southwestern Germany dated from 42 000 to 12 000 cal BP, comprising the early Upper Palaeolithic Aurignacian (42 000 to 35 000 cal BP), the mid-Upper Palaeolithic Gravettian (35 000 to 30 000 cal BP) and the late Upper Palaeolithic Magdalenian (17 000 to 14 000 cal BP)[3]. The variability of different ornament shapes is remarkable (Wolf 2015; Wolf 2019). This especially holds true for the Aurignacian and Magdalenian objects from different cave sites.

This chapter presents ornaments from the following cave sites of the Ach and Lone Valleys, each presented according to the beginning of the research history (Fig. 1): Hohle Fels, Sirgenstein, Brillenhöhle, and Geißenklösterle as well as Bockstein, Vogelherd, and Hohlenstein-Stadel. Furthermore, the ornaments from the sites Petersfels and Gnirshöhle in the Bruder Valley near the city of Engen, Konstanz District, are discussed.

## Presentation of the sites and the artefacts

### Ach Valley

Hohle Fels, near Schelklingen, Alb-Donau-Kreis District, is a large cave located 7 m above the Ach River. Excavations at the site began in 1870 with O. Fraas and T. Hartmann, followed by R. R. Schmidt, G. Riek, and J. Hahn in the early to mid-20$^{th}$ century (Fraas 1872; Schmidt 1912; Conard 2002). Since 1997, N. Conard has directed annual excavation campaigns (Fig. 2)[4]. The Upper Palaeolithic layers are attributed to the Aurignacian (Vb, Vab, Vaa, Va, IV, IIIb, IIIa, and IIe;

2 E.g. Taborin 1995; Rigaud et al. 2015; White 2007; Wolf/Conard 2015.

3 Conard/Bolus 2003; Conard/Bolus 2008; Conard/Rots 2024; Bataille/Conard 2018; Schürch et al. 2024.

4 Conard/Uerpmann 1999; Conard/Malina 2010; Conard/Malina 2016; Conard/Wolf 2020.

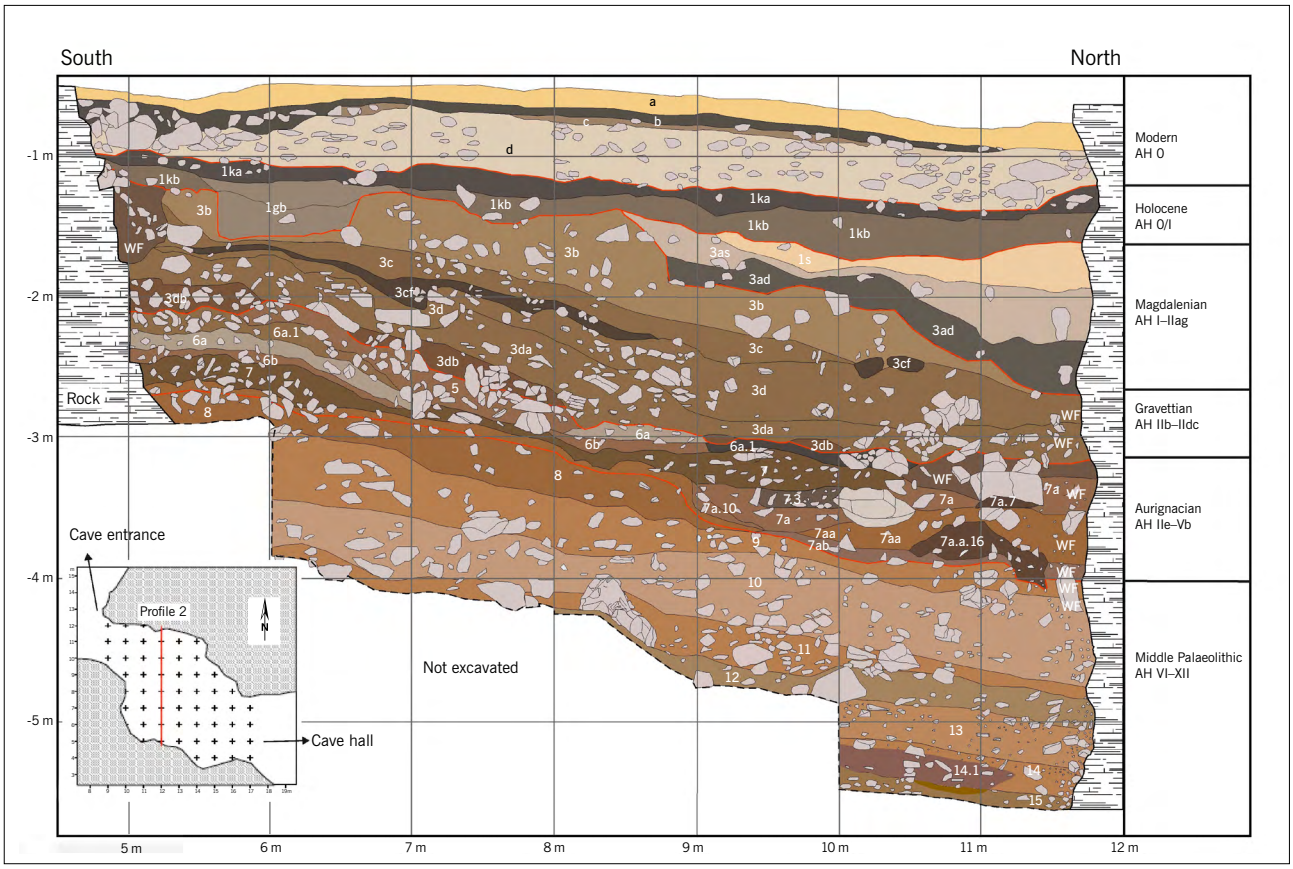


**Fig. 3** Hohle Fels. North-South Profile. Geological and archaeological horizons ranging from the Holocene to the Middle Palaeolithic. State of the art 2023.

***Abb. 3*** *Hohle Fels. Nord-Süd-Profil. Geologische und archäologische Horizonte vom Holozän bis ins Mittelpaläolithikum. Stand 2023.*

Conard/Bolus 2008; Bataille/Conard 2018); the Gravettian (IId, IIcf, IIc, and IIb), and the Magdalenian (IIa and I; Fig. 3; Taller 2014; Taller/Conard 2016). Extraordinary artefacts found at the site include a diverse array of personal ornamentation (Kölbl/Conard 2003; Wolf 2015; Wolf/Heckel 2018), ivory figurines[5], the earliest known flute made from bird bone (Conard et al. 2009), perforated batons *(Lochstäbe)* and chisels made from mammoth ivory (Conard/Rots 2024; Wolf et al. 2025a), as well as evidence of pigment processing alongside painted stones (Wolf et al. 2018; Velliky et al. 2018). The published Aurignacian ornament assemblage comprises 242 items. Of these, 217 mammoth ivory beads have been analysed, and more than half of the artefacts (127 objects) are double perforated beads in all stages of production (Fig. 4). So far, 44 Gravettian tear-drop-shaped beads (Vercoutère/Wolf 2018; Velliky et al. 2021) and 48 perforated animal teeth have been unearthed from both periods (Kölbl/Conard 2003; Walter et al. 2024) (Fig. 5–7). The Magdalenian ornaments derive from layers 0–IIa. The ornamentation includes 34 reindeer teeth. In addition, eight molluscs and seven *dentalia* were found. Five pieces are made from jet, and three pieces are made from ivory.

The unperforated figure-of-eight-shaped beads made from mammoth ivory are not listed here (see Conard 2003a), as the dating of this particular type of ornament is open to debate.

### *The female depictions*

In 2008, in the lowest Aurignacian horizon Vb, nine fragments of a female figurine were excavated and refitted to a 6 cm high figurine (Fig. 8; Conard 2009; Conard 2010). E. Dutkiewicz et al. (2024) describe the figurine as follows:

»The figurine is almost completely preserved, only the left arm and shoulder are missing. The posture is somewhat asymmetrical, with the right shoulder slightly raised. There is no head; instead, there is a loop above the left shoulder. Below the broad shoulders, the large breasts protrude noticeably forward. Both arms are held close to the body. The carefully designed hands rest below the breasts on the upper abdomen. The oversized vulva is shown with the labia open. The thighs are slim and stand out from each other and the legs end below the knees. The figure bears markings everywhere except for the legs and buttocks. On the front, ten nearly parallel lines that are long and deeply

5 Conard 2003b; Conard 2009; Dutkiewicz 2021; Dutkiewicz et al. 2018.

**Fig. 4** Personal ornaments carved from mammoth ivory from the Swabian Aurignacian. 1 Double perforated bead; 2 double perforated bead with wedge-shaped extension; 3 single perforated bead; 4 discoid bead; 5 ring-shaped bead; 6 basket-shaped bead; 7 figure-of-eight-shaped bead; 8 unperforated, constricted bead; 9 elongated bead; 10 globular bead; 11 single perforated bead with round extension; 12 incised, triple perforated bead; 13 preform of a bead; 14 bandeau. Hohle Fels: 4, 5, 7, 8, 11–14; Vogelherd: 1–3, 6, 9, 10.

***Abb. 4*** *Aus Mammutelfenbein geschnitzte Schmuckstücke aus dem Schwäbischen Aurignacien. 1 Doppelt durchlochte Perle; 2 doppelt durchlochte Perle mit keilförmigem Fortsatz; 3 einfach durchlochte Perle; 4 scheibenförmige Perle; 5 ringförmige Perle; 6 körbchenförmige Perle; 7 achtförmige Perle; 8 knebelförmige Perle; 9 längliche Perle; 10 kugelförmige Perle; 11 einfach durchlochte Perle mit rundem Fortsatz; 12 eingeschnittene, dreifach durchlochte Perle; 13 Vorform einer Perle; 14 Bandeau. Hohle Fels: 4, 5, 7, 8, 11–14; Vogelherd: 1–3, 6, 9, 10.*

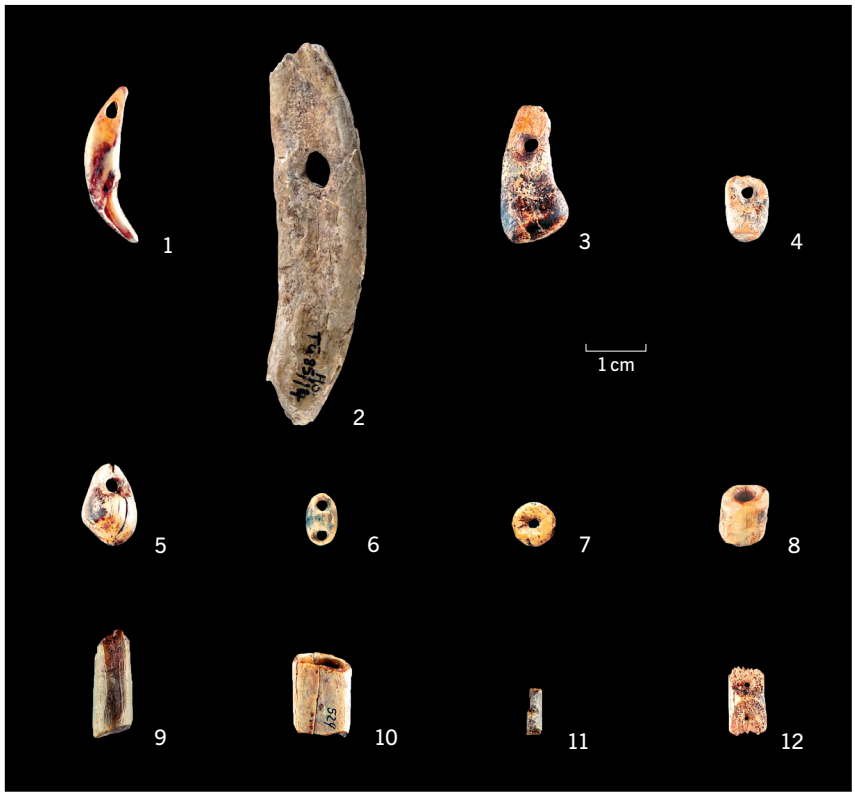


**Fig. 5** Personal ornaments of the Aurignacian of southwestern Germany. 1 Fox canine; 2 horse incisor; 3 deer canine; 4 elongated bead; 5 basket-shaped bead; 6 double perforated bead; 7 disc-shaped bead; 8 tube-shaped bead; 9 raw form of a bead (soapstone); 10 tube-shaped bead (bone); 11 rod; 12 half product double perforated bead. 4–8, 11, 12 made from mammoth ivory. Hohle Fels: 1–3, 5–8, 11, 12; Geißenklösterle: 4, 9, 10.

***Abb. 5*** *Schmuckstücke des Aurignaciens aus Südwestdeutschland. 1 Fuchseckzahn; 2 Pferdeschneidezahn; 3 Hirscheckzahn; 4 längliche Perle; 5 körbchenförmige Perle; 6 doppelt durchlochte Perle; 7 scheibenförmige Perle; 8 röhrenförmige Perle; 9 Rohform einer Perle (Speckstein); 10 röhrenförmige Perle (Knochen); 11 Stab; 12 Halbfabrikat einer doppelt durchlochten Perle. 4–8, 11, 12 aus Mammutelfenbein. Hohle Fels: 1–3, 5–8, 11, 12; Geißenklösterle: 4, 9, 10.*

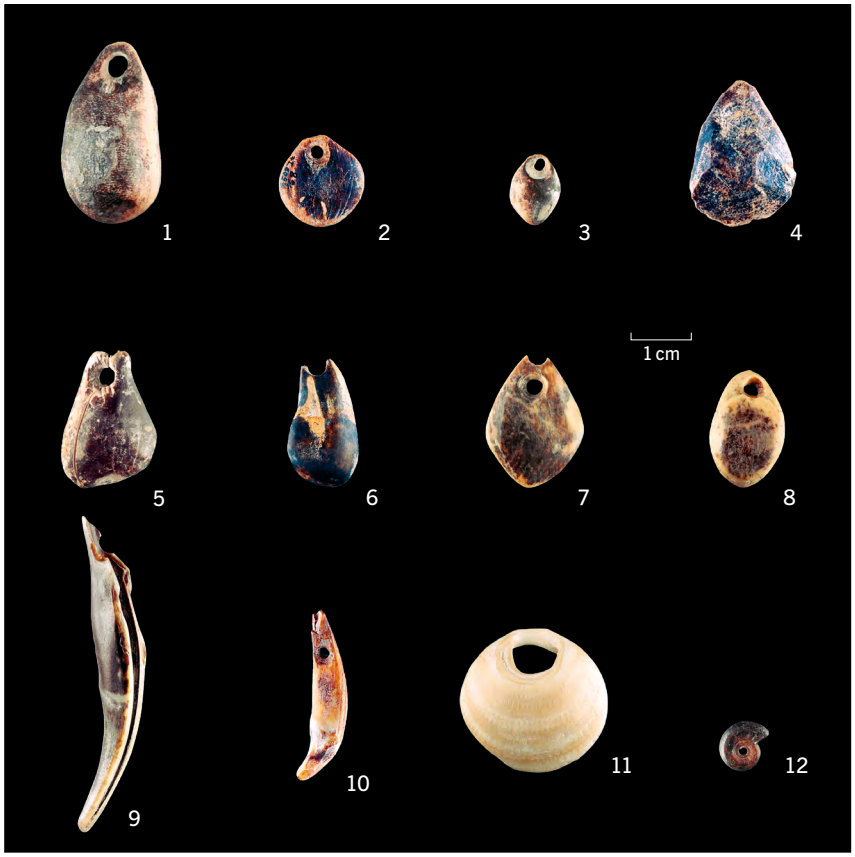


**Fig. 6** Personal ornaments of the Gravettian of southwestern Germany. 1–3 Tear-drop-shaped beads; 4 raw form of a tear-drop-shaped bead; 5 facsimile of a deer canine; 6 deer canine; 7 reused bead; 8 bead with lateral decoration; 9 split wolf canine; 10 cave bear canine; 11 mollusc *Glycymeris pilosa*; 12 ammonite. 1–5, 7, 8 made from mammoth ivory. Hohle Fels: 7–9, 11; Geißenklösterle: 1–6, 10, 12.

***Abb. 6*** *Schmuckstücke des Gravettiens Südwestdeutschlands. 1–3 Tropfenförmige Perlen; 4 Rohform einer tropfenförmigen Perle; 5 Faksimile eines Hirscheckzahnes; 6 Hirscheckzahn; 7 wiederverwendete Perle; 8 Perle mit seitlicher Verzierung; 9 gespaltener Wolfseckzahn; 10 Höhlenbäreneckzahn; 11 Molluske* Glycymeris pilosa*; 12 Ammonit. 1–5, 7, 8 aus Mammutelfenbein. Hohle Fels: 7–9, 11; Geißenklösterle: 1–6, 10, 12.*

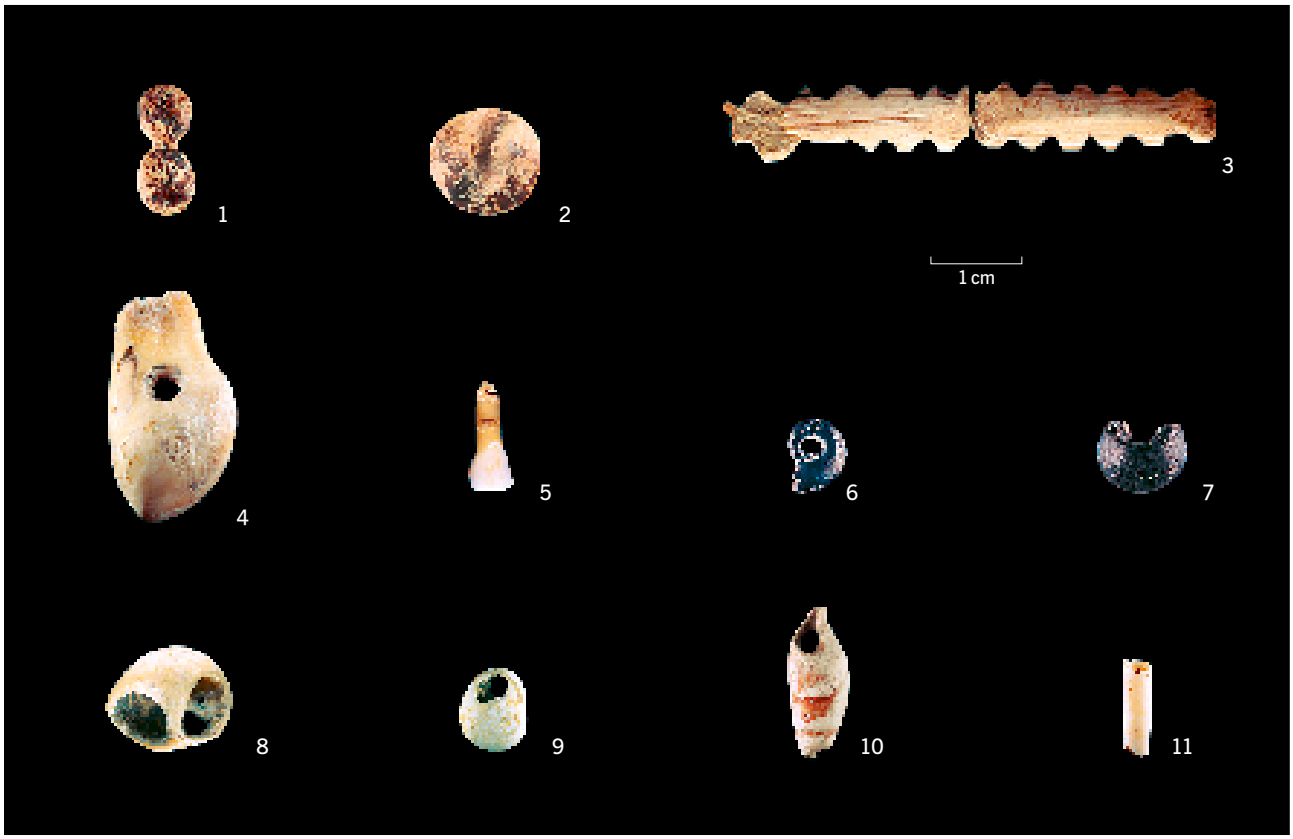


**Fig. 7** Personal ornaments of the Magdalenian from Hohle Fels. 1 Toggle-shaped bead; 2 button; 3 notched bandeau; 4 deer canine; 5 incised reindeer incisor; 6 ammonite; 7 bead (jet); 8 mollusc *Littorina obtusata*; 9 mollusc *Cyclope neritea*; 10 mollusc *Melanopsis kleini*; 11 *dentalium*. 1–3 Made from mammoth ivory.

***Abb. 7*** *Schmuckstücke des Magdaléniens des Hohle Fels. 1 Knebelförmige Perle; 2 Knopf; 3 gekerbtes Band; 4 Hirscheckzahn; 5 eingeschnittener Rentier-Schneidezahn; 6 Ammonit; 7 Perle (Gagat); 8 Molluske* Littorina obtusata*; 9 Molluske* Cyclope neritea*; 10 Molluske* Melanopsis kleini*; 11* Dentalium*. 1–3 Hergestellt aus Mammutelfenbein.*

**Fig. 8a–b** Hohle Fels. Female figurine made from mammoth ivory. Length 6.0 cm.

***Abb. 8a–b*** *Hohle Fels. Weibliche Figurine aus Mammutelfenbein. Länge 6,0 cm.*

cut run horizontally across the entire abdomen. There are twelve thin radial lines on the lower abdomen, which radiate out roughly from the navel. On the backside of the figure, a long and curved line runs along the shoulder girdle. Along this line, vertical parallel notches are placed, only nine of which are preserved; the sequence could have included one to three additional notches along the missing left shoulder. A few lines are loosely scattered across the entire back with a concentration in the waist area. A pattern of four U-shaped, concentrically arranged long lines runs over the flat upper breast from the tip of one breast to the other. The outside of the right breast bears two sequences of six and four parallel, vertical lines, respectively. There are another four parallel, vertical lines on the outside of the left breast and three on the inside. On both shoulder parts, there are three long parallel lines mirrored on each side. Starting at the shoulder on the right arm is a pattern of a sloping line with two parallel lines directly below it. There are six parallel lines along the upper arm and four more on the forearm. At the wrist, there are two rows of four and two dots. It can be assumed that the left missing arm was also decorated with markings since the patterns on this figurine are applied symmetrically« (Dutkiewicz et al. 2024, 181–182).

Other fragments of female figurines have been recovered in AH Vb and AH Vaa that bear similar markings or decoration patterns and are therefore interpreted as possible parts of female figurines (Fig. 9; Conard/Malina 2015; Dutkiewicz 2021; Dutkiewicz et al. 2024).

### *Interpretations*

Instead of a head, the carver created a ring through which a cord could be threaded. Several explanations for this exist. The head of the figure may have been intentionally omitted, perhaps symbolically represented by the ring itself or being perceived as analogous to the head of a female figurine. The wearer her- or himself becomes the figure by wearing it on a cord around the neck – the human head thus becomes the head of the female figure (Fig. 10). Another possibility is that the head was made from a more perishable material than ivory and was attached to the figurine (Stannard/Langley 2021). A further option is that a head was originally present but later broke off or was intentionally removed, with the resulting surface then reworked to its current state. Finally, there is the obvious assumption that the figurine was intentionally designed in its current headless form. The patterns on the arms, chest, shoulders, and back may represent body decoration. This could have been painting, tattoos, or scarification (Wadley 2016). The clearly visible navel on the female figurine suggests that these patterns are on bare skin. They follow the anatomical details of the body, emphasising the abdomen and breasts. Both cultural traditions and personal preferences likely influenced the composition and selection of these patterns. It is reasonable to assume that the patterns on different body parts convey deeper symbolic meaning. The emphasis on the female body's anatomical details may relate to aspects of fertility. The irregular lines on the back could depict decora-

**Fig. 9** Hohle Fels. Fragment of a female figurine made from mammoth ivory. Length: 2.5 cm.

***Abb. 9*** *Hohle Fels. Fragment einer weiblichen Figurine aus Mammutelfenbein. Länge: 2,5 cm.*

**Fig. 10** Reconstruction of an Aurignacian woman.

***Abb. 10*** *Rekonstruktionsvorschlag einer Frau aus dem Aurignacien.*

tion, wrinkles, or stretch marks. The lines in the waist area resemble skin folds like those found in corpulent women. They might also represent a belt, but the short lines are not connected to a single, distinct form, and the pattern does not continue on the front. Nevertheless, the indicated belt as well as the slightly slanted lines on the stomach could indicate a baby sling. In this case, the protruding breasts would be the backs of the heads of two babies carried side by side in the sling, facing the wearer[6]. This assumption seems legitimate in a hunter-gatherer community, and a garment

6 Consideration expressed by H. Müller-Beck 2009, discussed with S. Wolf.

would be implied. However, the anatomical details of the large breasts, the open vulva, and the relaxed abdomen are all characteristic of a woman's body shortly after childbirth (Conard 2010). N. J. Conard (2010) does not assume that the figurine represents a specific actual individual. Rather, the figurine depicts a woman just after birth and a more general concept of reproduction and fecundity. He sees the figurine as belonging within a female social realm in connection with reproduction and birth, and perhaps in the context of Palaeolithic midwifery. The figurine could also have been passed between mothers and daughters over generations. M. Porr (2010) shares aspects of this view. G. Morris-Kay (2010) supports the idea of a depiction of a woman shortly after giving birth. However, she sees the figure as a self-portrait of a young mother confronted with her changed body. According to G. Morris-Kay, this woman would have worked and worn the pendant for her own purposes. The markings on the female figurine also suggest a connection with pregnancy (Dutkiewicz 2021; Dutkiewicz 2023). The twelve radial lines emphasise the lower abdomen, and the ten horizontal, deeply incised lines across the stomach are particularly striking. Before ultrasound technology, fundal height – the position of the uterus in the abdomen – was used to determine the stage of pregnancy (Beazley/Underhill 1970; Morse et al. 2009). Instructional diagrams often illustrate the fundal height with horizontal lines on the abdomen, corresponding to the weeks of gestation. At the end of pregnancy, the fundus reaches just below the breasts. These horizontal lines on the figurine's abdomen, in conjunction with other signs of postpartum, may reflect these uterine positions. This interpretation is supported by the fact that the ten lines correspond to the ten months of a lunar pregnancy (Dutkiewicz 2021; Dutkiewicz 2023). The markings of the vulva, however, are quite different. Unlike the clearly defined markings on the upper body, the incisions in this area are rather imprecise, appearing quickly and roughly executed. They fill the entire pubic triangle, culminating in the vulvar cleft. This, in contrast to the static markings on the upper body, suggests action, as if this area was repeatedly modified. The continuous incisions suggest an ongoing activity, emphasising the process of cutting. E. Dutkiewicz et al. (2024) identified three distinct zones of markings on the Hohle Fels female figurines. The first zone represents the body with its specific characteristics, likely depicting body decoration such as painting, tattooing, or scarification. All aspects may have been integral to a woman's appearance in the Swabian Aurignacian society. In any case, a specific individual is not depicted (Conard 2010). The second zone reflects numerical, calendric, and potentially medical significance, likely representing the notation of a pregnancy's progression over ten lunar months. The third zone, the vulva, shows evidence of repeated working, even after the figure's initial completion. The notation of pregnancy progression, the focus on the abdomen, and the ›opening‹ of the vulva all support the argument that this figure is directly related to fertility, specifically pregnancy and childbirth. The fact that it was also a pendant suggests its use as a personal amulet or apotropaic object during that crucial time for an expectant mother. The fact that the perforation is polished and was used over a long time speaks in favour of passing on this object from generation to generation and its value to the Aurignacian users.

### Sirgenstein

The cave entrance area and the terrace of the Sirgenstein were excavated by R. R. Schmidt in 1906. The sequence of layers with archaeological remains was about 2.20 m. It ranges from the Middle Palaeolithic to the Magdalenian (VIII–I; Schmidt 1912; Bolus/Conard 2012). When examining soil samples of the Aurignacian layer IV, R. R. Schmidt found a double perforated bead that was broken lengthwise so only one half is preserved.

### Brillenhöhle

The Brillenhöhle in the Ach Valley near Blaubeuren, Alb-Donau-Kreis District, is located 80 m above the Ach River (Riek 1973). G. Riek conducted the first excavations there between 1955 and 1963, and excavations have continued since 2021 under the direction of Y. Tafelmaier (2023). The Upper Palaeolithic layers include a small Aurignacian assemblage (AH XIV), a Gravettian inventory (AH VII to V) and a Magdalenian component (AH IV). G. Riek noted 33 characteristic tear-drop-shaped beads from the Gravettian layers (Riek 1973). The Brillenhöhle is also well-known for Magdalenian human remains, which provide evidence of secondary burial practices and/or cannibalism (Orschiedt 2002; Sala/Conard 2016). The Magdalenian horizon IV revealed five notched ivory bands (Riek 1973), the function of which is still unclear (Fig. 3,1–3; Taller 2014). However, these can be considered as ornaments.

### Geißenklösterle

Geißenklösterle Cave, located a short distance from Hohle Fels near Blaubeuren, is a partially collapsed cave situated 60 m above the Ach River (Hahn 1988). Discovered in 1958, the site has been excavated in multiple campaigns by E. Wagner (1973), J. Hahn (1974–1991), and N. Conard (2001–2002). The Upper Palaeolithic layers consist of the Lower Aurignacian (AH III), the Upper Aurignacian (AH II), the Gravettian (AH I), and a very small Magdalenian component (AH Io; Richter et al. 2000; Higham et al. 2012). Like Hohle Fels, Geißenklösterle contains abundant evidence of symbolic material culture, including ivory figurines, bone and ivory flutes, personal ornamentation, and a painted stone[7]. As Aurignacian ornaments, three perforated fox teeth, two pendants, a minimum of 13 beads made from mammoth

7 Hahn 1982; Hahn 1986; Hahn 1988; Floss 2015; Wolf 2015; Dutkiewicz 2021.

**Fig. 11a–b** Geißenklösterle. Adorant, made from mammoth ivory. Length: 3.8 cm.

***Abb. 11a–b*** *Geißenklösterle. Adorant, geschnitzt aus Mammutelfenbein. Länge: 3,8 cm.*

ivory (therefrom ten double perforated beads) and three ivory bandeaux are known. From the Gravettian layers, 65 tear-drop-shaped beads are published (Scheer 1985). No Magdalenian personal ornaments were excavated.

*Adorant*

In 1979, Hahn discovered the so-called ›Adorant‹ in Geißenklösterle Cave (Fig. 11; Hahn 1982). This rectangular, thin ivory plate measures 3.8 cm in length. One side features a relief depicting a human figure in a symmetrical frontal pose. The arms are slightly bent and raised, with the head extending above the upper edge. The legs are slightly bent, and the feet point outwards. Between the feet is an elongated appendage that hangs down. This feature is particularly interesting, as it has been interpreted as an animal's tail (Hahn 1986). G. Rücklin (1995), however, interprets the depiction as a birth scene. The Adorant's arms are marked with three lines on the right and seven on the left. Four lines are visible on the top of the head, possibly representing hair (Dutkiewicz 2023). Dutkiewicz suggests these markings are directly related to the human figure, reflecting features such as hairstyle and body decorations like tattoos, scarification, or paint. The edges of the Adorant bear notches: 13 on the sides, seven at the top, and six at the bottom. On the back of the plate are four rows of dots, numbering 13, 10, 12, and 13, respectively. The numbers of notches and dots are often associated with observations of lunar phases and lunar calendars (Dutkiewicz 2023).

## Lone Valley

### Bockstein

L. Bürger first excavated the Bockstein Cave in 1883/84. Later, R. R. Schmidt also excavated in the cave in 1908 (Schmidt 1912; Wetzel 1958). The artefacts derive from mixed layers, but they range from the Middle Palaeolithic to the Mesolithic, with a focus on the Aurignacian artefact types (Hahn 1977). Two perforated cave bear canines are known, which are of an Aurignacian age. In the Bockstein-Törle, the original entrance to the Bockstein Cave, layers VIII to II revealed archaeological remains from the Middle Palaeolithic to the Neolithic (Wetzel 1954). Here, three personal ornaments made from clay shale, as well as two mammoth ivory pendants, one preform, and one broken item are known that probably date to the Aurignacian (Wolf et al. 2013).

## Hohlenstein-Stadel

The Hohlenstein complex is located in the municipality of Asselfingen, Alb-Donau-Kreis-District. The complex contains two caves, the Bärenhöhle (Bear Cave) and the Stadel. The Abri Kleine Scheuer is situated between these two caves, and the Ostloch (East Hole) is located to the east, above the Stadel. In 1861, O. Fraas began the first research into the Prehistory in the Bärenhöhle. Between 1937 and 1939, R. Wetzel conducted excavations in the Stadel, employing a system of arbitrary layers (German: *Hieb*), where each layer, approximately 20 cm thick, was excavated using a hand pick. In the 20th m, 6th *Hieb*, nearly 300 fragments of worked ivory were discovered. Later on, these fragments were refitted to the Lion Man figurine, the first hybrid creature – half man, half lion – in human history[8]. After World War II, from 1953 onwards, R. Wetzel continued his work in the Lone Valley, excavating at and within the Hohlenstein between 1954 and 1961 (Wetzel 1961). Under the direction of C.-J. Kind, renewed excavations began in 2009 in the Stadel, focusing on the area above the 20th excavation metre from the 1939 excavations (Kind/Beutelspacher 2010). The remaining excavation metres from the 1939 campaign were documented, and *in situ* sediments were excavated and recorded (Kind/Beutelspacher 2010; Beutelspacher et al. 2011; Beutelspacher/Kind 2012). The Palaeolithic layers range from the Magdalenian to the Middle Palaeolithic (levels C to F). A new radiocarbon date from the Aurignacian layer (Au) yielded an age of 35185 ± 270 BP (ETH-38797: Beutelspacher et al. 2011), roughly calibrated to ~ 40 500 cal BP. During the 1939 excavation, eight personal ornaments were unearthed near the fragments of the Lion Man figurine[9]. These are six fox teeth (one is currently unavailable for study) and two unique mammoth ivory pendants: a globular one and a basket-shaped form (Wolf et al. 2013). The backdirt excavations delivered eleven pieces of personal ornaments. These artefacts include one ivory bead, similar in shape to the globular one found in the 1939 excavation, as well as eight fox teeth, one wolf tooth, and a deer canine decorated with carvings on both sides (Wolf et al. 2013). The deer canine shows two short carvings on its upper half and four longer carvings on the opposite end, its lower half. The assemblage includes seven fox canines, three incisors, two premolars, and one root fragment. Using geometric-morphometric analysis, Ostermann identified five specimens suitable for species identification: two canines from red fox and three from arctic fox. F. Venditti et al. (2023) recently investigated the perforation methods used on all 13 fox teeth. The Aurignacians longitudinally scraped all 13 teeth to flatten and thin the roots, leaving visible long, irregular striations. The perforations were created using the same method: flattening the surface until perforation, and then widening the hole with bifacial semi-rotation, resulting in a bi-conical perforation. Of the teeth with complete perforations, five show well-developed rounding of their internal and external rims.

### *Lion Man*

The Lion Man figurine has been professionally restored twice: in 1988 at the Württemberg State Museum (Schmid 1989) and in 2012/13 at the State Office for Heritage Preservation of Baden-Württemberg (Kind et al. 2014). The characteristics of a lion, such as the short snout and cat-like ears, are unmistakable. The Lion Man stands upright with slightly parted legs. It is made from a whole mammoth tusk. While the head is clearly that of a lion, its position, combined with the upright posture, is that of a human. The muzzle is broad, marked by two deep lines defining the nose and mouth. The eyes, while positioned laterally, face forward. Also, the ears are characteristic of a lion. The neck is notably broad, merging almost seamlessly into the back and shoulders. The shoulder blades are clearly defined. The arms, terminating in lion-like paws, are slightly bent and held close to the body, not touching the torso. The torso is elongated, giving the figure a somewhat stretched appearance. The legs are spaced roughly shoulder-width apart and exhibit clearly human characteristics, including knees and curved calves, ankles, and heels. Notably, the feet are not horizontal, suggesting the figure is standing on tiptoe. Although much of the original surface is now lost, some areas remain along the head and neck, the collarbones, and the lower abdomen. These preserved areas include the large, deep navel and an extension in the groin area (Kind et al. 2014). The detached extension could represent either a stylised penis or a loincloth (Kind et al. 2014). Eight wide, deep notches are visible on the left upper arm. The final two notches near the elbow are partially preserved, with the last represented by only a few cuts (Dutkiewicz et al. 2024). Hatching on the rear left ear is also clearly visible. These incisions could be interpreted as tattoos or scarification.

The upright posture with the human lower body and navel, combined with the elongated upper body, lion's paws, and lion's head, suggests the depiction of a hybrid creature: the so-called Lion Man as it has often been described (e.g. Wehrberger 2013; Kind et al. 2014). However, given the proportions, it could also represent a human wearing a lion skin, including the head. In this interpretation, the visible lion's head would be a type of headdress, representing a Palaeolithic clothing element.

## Vogelherd

Vogelherd Cave is located in the Lone Valley near the town of Niederstotzingen, Heidenheim District. G. Riek and his team excavated the entire cave down to bedrock in 1931 (Riek 1934). The archaeological layers, numbered I–IX, range from the Neolithic (I) and Magdalenian (II–III) through the Aurignacian (IV–V) and Middle Palaeolithic (VI–VIII), down to the Last Interglacial (IX). The Aurignacian layers IV and V were the most prolific in finds (Conard/

8 Hahn 1986; Schmid 1989; Kind et al. 2014; Wehrberger 2013.

9 Hahn 1970; Schmid 1989; Wehrberger 2013; Kind et al. 2014.

**Fig. 12** Vogelherd. Mammoth figurine, made from mammoth ivory. Length: 5 cm.

***Abb. 12*** *Vogelherd. Mammut-Figurine, geschnitzt aus Mammutelfenbein. Länge: 5 cm.*

Bolus 2023; Conard/Bolus 2008). Recent radiocarbon dates suggest Magdalenian occupation of this site as early as 17 000 years cal BP (Schürch et al. 2024). Within the Aurignacian layers, G. Riek unearthed eleven figurative artworks (Riek 1934; Hahn 1986; Dutkiewicz 2021), but no beads made from mammoth ivory. Interestingly, two artworks are also pendants or amulets. A mammoth figurine (length 5 cm) made from ivory as well as the half-relief of a mammoth made from bone bear perforations (Fig. 12): The mammoth figurine shows perforations between front and hind legs and if the trunk had not been broken, this would have been a third possibility for suspending this figurine and the half-relief has a broken eyelet at one end.

N. Conard conducted backdirt excavations between 2005 and 2012 and again in 2022–2023 (Conard/Malina 2006; Conard et al. 2007). This work resulted in the discovery of hundreds of personal ornaments, as well as fragments of figurative artworks and flutes (Conard et al. 2009; Wolf 2015; Dutkiewicz 2021). Between 2005 and 2012, as well as in 2021 and 2023, more than 400 personal ornaments in all stages of their production were recovered, with 346 mammoth ivory beads being analysed and published (Wolf 2015; Wolf/Conard 2015). Due to the similar morphology of personal ornaments from the Ach Valley sites with intact stratigraphies, the personal ornaments from Vogelherd could be clearly linked to the Aurignacian. The double-perforated bead dominates the inventory with 219 items in all stages of manufacture. Eight pendants from animal teeth, such as deer, horse and cave bear, were also recovered at this site (Fig. 13; Wolf et al. 2025b).

## Bruder Valley

### Petersfels

The Petersfels Cave site is located in the Brudertal Valley near the city of Engen. E. Peters excavated the site and its forecourt from 1927 to 1928 and again in 1932 (Peters 1930; Peters/Toepfer 1932). G. Albrecht conducted excavations between 1974 and 1979 on the valley floor (Albrecht 1979; Albrecht et al. 1983). E. Peters' campaigns yielded numerous lithic and osseous artefacts, examples of craftsmanship, and animal bones attributed to the Magdalenian, but lacked a reliable stratigraphy (Albrecht/Hahn 1991; Mauser 1970; Pfeifer 2016). Based on the archaeological material and faunal remains, the main occupation undoubtedly occurred during the Upper Magdalenian. The numerous jet pendants (n = 186) are present in all stages of production, from rough forms to finished or broken pieces (Fig. 14).

**Fig. 13** Swabian Jura cave sites, ornaments made from animal teeth from the Upper Palaeolithic; no scale.

***Abb. 13*** *Höhlenfundstellen der Schwäbischen Alb, Tierzahnschmuck aus dem Jungpaläolithikum; o. M.*

**Fig. 14** Petersfels. Magdalenian personal ornaments made from jet; no scale.

***Abb. 14*** *Petersfels. Schmuckstücke des Magdaléniens, geschnitzt aus Gagat; o. M.*

P. F. Mauser (1970, 78–79) identifies crescent-shaped to triangular, barrel-shaped and double-perforated, and oval to spectacle-shaped pendants as the primary forms. The 19 female jet figurines were also mostly pendants, as they exhibit a perforation in the upper third (described in detail in Mauser 1970). P. F. Mauser suggests that the excavated figurines were worn as pendants, hanging upside down. In addition to these ornament pieces, »several pounds of raw material« (Mauser 1970, 74) were found in the immediate vicinity which included jet and lignite (Peters 1930; Mauser

**Fig. 15** Examples of ornamental molluscs: *Glycymeris* from the Gravettian layers of Hohle Fels and Geißenklösterle Caves as well as the Magdalenian of Hohle Fels Cave *(Littorina obtusata)*; no scale.

***Abb. 15*** *Beispiele von Schmuckmollusken:* Glycymeris *aus den Gravettien-Schichten der Höhlen Hohle Fels und Geißenklösterle sowie aus dem Magdalénien vom Hohle Fels* (Littorina obtusata)*; o. M.*

1970). Furthermore, a total of »82 perforated mussel and snail shells [...], 43 unperforated mussel and snail shells [...], a dozen fossilized shark teeth [...], [and] over two kilograms of Jurassic fossils [...]« (Mauser 1970, 80) were excavated. It remains unclear whether these items were brought into the cave for further processing into ornaments. In total, 239 ornaments have been published (Wolf 2019). The holes in 71 of the perforated mussel and snail shells P. F. Mauser counted are likely of natural origin. The identified specimens originate from the Mainz Basin, the Steinheim Basin, and the upper Danube region. B. Schürch et al. (2021) investigated the Glycymeris of Petersfels Cave and it turned out that a minimum of 54 completely preserved items of more or less the same size exist from this site. Ochre adhered to many of them; they were likely used as ornaments (Fig. 15).

### Gnirshöhle

The excavations conducted by the University of Tübingen in 1977 in the Gnirshöhle Cave yielded a double-perforated bead made from jet, two molluscs of the species *Nucella lapillus* originating from the Atlantic Ocean, two fossilised molluscs of the genus *Sycum* from the Tertiary Paris Basin, and one mollusc, likely *Astarte montagui* (Albrecht et al. 1977). The origin of these molluscs differs from those found in the Petersfels site. Therefore, G. Albrecht et al. (1977) suggest that different groups occupied the nearby caves, possibly without close contact.

## Discussion

The full meaning of personal ornaments in the Palaeolithic will remain elusive since Upper Palaeolithic hunter-gatherers cannot share their motivations or explain how they used ornamentation. Some pieces, or ways of wearing them, were likely reserved for specific individuals, complicating our understanding of their significance. Even in contemporary societies, the meaning of personal adornment is sometimes revealed only through direct inquiry. However, within a society sharing common rules and conventions, individuals can generally grasp and interpret the meaning of another person's ornaments. The message conveyed by such adornments is often immediately understood, requiring no extensive explanation. Personal ornaments can serve practical functions, such as acting as a button or clasp. Nevertheless, they also possess ornamental value. Pendants might function as amulets believed to bring good fortune or offer protection. Ornaments commonly act as status symbols (Deimel 2005) and can be used in religious or ritual contexts[10]. The full complexity of the meaning of ornamentation is best understood by members of a community. This was also the case during the Upper Palaeolithic. Personal ornaments serve as a means of communication within a society (Taborin 1995). Societies are often stratified into different groups, and individuals may use personal ornaments to assert their own status and value or, conversely, to signal that others are excluded from the community because they are unable or forbidden to wear particular pieces (Camps-Fabrer 1990; Kasten 2009). Some personal

10 For a synthesis of the diverse functions of ornaments in traditional societies, see Vanhaeren 2010.

ornaments, like rank badges, are earned and symbolise distinction. Ornaments can also be deeply personal, with their meaning understood only by the wearer. This is true of heirlooms, engravings, or seemingly insignificant keepsakes like locks of hair, which commemorate a person or event (Haidle 2003).

The emergence of diverse forms of personal adornment in Europe at the beginning of the Upper Palaeolithic, as evidenced by the discovery of numerous personal ornaments, suggests that self-perception and individual self-image were likely as important then as they are today. Creating and wearing personal ornaments likely required a strong sense of self and an awareness of form, which was then communicated to the group. We assume »that others not only perceive the object, but also recognize the extraordinary connection between the wearer and the object« (Haidle 2003, 13). Thus, personal ornaments also contribute to the creation of identity. The recurrence of a particular personal ornaments type within a site's artefact assemblage indicates its long-term popularity within a group and its consequent establishment as a marker of group identity. This standardisation over time reflects a stylistic and craft tradition. Furthermore, traditional personal ornaments attest to the social dynamics within a community. Ornaments help to create social identity and may imply group consensus, enabling individuals to consciously or unconsciously differentiate themselves from others.

Any discussion of Ice Age personal ornaments must consider the production and use of clothing. During the Upper Palaeolithic, people needed clothing for protection from the cold and damp. Clothing adapted to the prevailing climate was crucial for survival. The following discussion explores the hypothesis that clothing served as a medium for displaying personal ornaments, as well. During the Aurignacian, clothing was likely made from the skins and hides of various animals (Scheer 1984). Researchers like A. Scheer have conducted experiments to identify the materials available for working, tanning, and processing these hides (Scheer 1995). The process would have required stone tools, threads, cords, and sewing tools. Tanning could be achieved through either chemical or mechanical processes. Based on ethnological comparisons, mechanical methods such as scraping, stretching, chewing, or fulling are plausible for the Palaeolithic (Hatt 1969; Turcy 1986). Scraping, the simplest form of tanning, involves incorporating the animal's own fat into the hide. Once the leather was prepared, it could be dyed using substances like lime powder, hematite, or ochre, perhaps simply by rubbing the desired material into the leather. The production of rope from plant fibre was recently documented by N. J. Conard and V. Rots (2024) by examining a so-called *Lochstab* (perforated baton) from Hohle Fels. This indirectly shows that fibres were first made into threads, which were then twisted together to form a multi-strand rope. Cords and threads are, in turn, essential for the manufacture of clothing. Sinew, leather straps of varying thicknesses, plant fibres, or hair could have served as thread for sewing garments. Bone or ivory awls, common in the Aurignacian, could have been used to pierce leather or fur. It is important to determine whether and how the various ornamental pieces from the Swabian Aurignacian were attached to clothing or otherwise worn. This discussion assumes they functioned as adornments, not as currency. It should be reiterated that multiple uses for individual artefacts cannot be ruled out (e.g. Owen 2005), which certainly applies to personal ornaments. The absence of burials that might provide information about how the personal ornaments were worn means that these pieces could theoretically have been sewn onto clothing, used as bracelets, necklaces, leg ornaments, or even woven into hair. They might also have adorned containers, blankets, boots, and other objects, and their function was not necessarily limited to personal adornment (White 2007; Castets 2008, 50–54). J. Hahn suggested that the pieces from the Swabian Alb were sewn onto clothing (Hahn 1992). This assumption is supported by the small size of, for example, the double-perforated beads, which are unsuitable for stringing as a necklace. Single-perforated pieces, such as the basket-shaped beads, could, however, have been worn on a necklace. The non-perforated, constricted beads from Hohle Fels are flatter on one side and more curved on the other. Significantly, the flat side of these pieces is consistently more polished than the curved side. This is not attributable to sediment wear but rather to rubbing against a substrate, such as clothing, during use. Constant rubbing would have polished the flat side. This same polishing would also occur when worn directly against human skin. Furthermore, the perforations of many finished beads are completely rounded. This rounding is not a result of taphonomic processes, as unfinished beads from the same deposits exhibit irregular and frayed perforations. The smooth edges of the perforations on the majority of finished products are, therefore, due to polishing during use (Wolf 2015).

In general, the archaeological record provides little information about the specific patterns in which the beads were sewn. This brings us back to the challenge of being unable to make definitive statements about specific groups who might have defined themselves primarily through the arrangement of particular personal ornaments (White 2007). This is the case with various indigenous peoples and ethnic groups, which can determine a person's status based on a fixed arrangement of personal ornaments on the body (see, e.g. Deimel 2005). The present summary can only address the tradition of producing certain forms. While a fine-grained analysis and subdivision into paleo-ethno-linguistic groups is possible to some extent (Vanhaeren/d'Errico 2006; Rigaud 2011), it is clear that the human body functions as a signifier as soon as people wear personal ornaments (Collins/Nowell 2024).

The ornament assemblage of the Swabian Aurignacian is clearly dominated by double-perforated ivory beads (Fig. 16). The multiple creative expressions documented by the diverse ivory ornament forms are evident. Only a few similar types of beads are known from other Aurignacian regions in Europe. This suggests that the Swabian Aurignacians possessed a distinct group identity, characterised by the ornaments found in the Swabian cave sites (Wolf/Conard 2015). While connections with other regions through shared ornament forms have been demonstrated (Wolf et al. 2025b), a clear regional distinction based on the use of specific forms prevailed.

During the Gravettian, a change is evident. Tear-drop-shaped beads span the region from southwestern France to

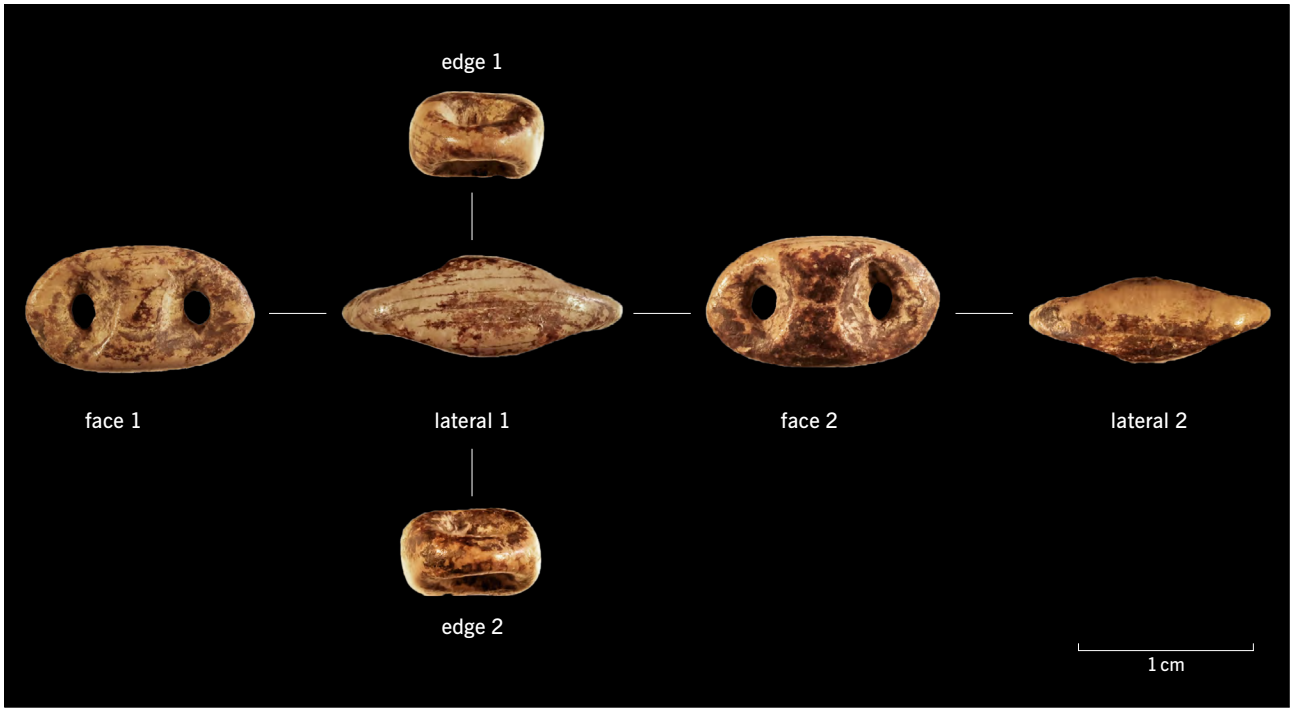


**Fig. 16** Vogelherd. Double perforated bead made from mammoth ivory.

***Abb. 16*** *Vogelherd. Doppelt durchlochte Perle aus Mammutelfenbein.*

the Obłazowa Cave, Lesser Poland Voivodeship, in Poland (Vercoutère/Wolf 2018). The connections within Europe are clearly discernible through this shared bead form. Following the Last Glacial Maximum (LGM), Magdalenian hunter-gatherers developed new preferences for ornaments compared to earlier techno-complexes. The use of jet, reindeer teeth, and molluscs dominates the known ornament assemblages. The molluscs originate from the Mediterranean Sea and the Paris Basin, once again demonstrating the extensive networks and exchange systems that existed around 16 000 years ago (Wolf 2019). This behaviour aligns with the observation that the Magdalenian people differed genetically from pre-LGM hunter-gatherers in Europe (Posth et al. 2016; Posth et al. 2023) and that they had different priorities and preferences concerning raw materials (Maier 2015). Furthermore, with the reduced availability of mammoth ivory, the Magdalenian groups found other readily available raw material sources for their ornaments.

Throughout the Upper Palaeolithic, modified animal teeth consistently served as ornaments. While there are slight differences in the use of various animal species, these are not statistically significant due to the relatively small number of pendants overall, especially in comparison with the use of mammoth ivory and jet. Fox teeth and deer canines were used during the Aurignacian, Gravettian, and Magdalenian. Perforated horse incisors, however, prevail within the Gravettian. The use of bear teeth for ornaments slightly increases during the Gravettian. The tradition of wearing female figurines as pendants was a widespread phenomenon in the European Upper Palaeolithic (see Wolf 2015). In southwestern Germany, this tradition spans from the female figurine of Hohle Fels Cave to the more abstract female figurine pendants of Petersfels. Palaeolithic hunter-gatherers used these figurines as pendants for personal adornment.

## Conclusion

Compared to the preceding Middle Palaeolithic of the Swabian Jura, during which convincing personal ornaments are not known, the Upper Palaeolithic is characterised by a great abundance of personal ornaments produced in numerous forms using multiple raw materials. This shift reflects a demonstrable need for these hunter-gatherers to present themselves. The abundance and diversity of ornaments testify to a sense of beauty, aesthetics and identity. Regional and temporal preferences for materials and forms reflect fashion trends and stylistic choices. Traditions are identifiable through distinctive personal adornments. Surprisingly, the different traditions remain largely constant within each Upper Palaeolithic cultural group; they reflect different social needs and expressions throughout the 30 000 years of the Upper Palaeolithic of southwestern Germany. A complex picture emerges of the use of ornaments in the Upper Palaeolithic, yet prehistoric finds offer only a fragmentary glimpse into the daily practices of these ancient people. We assume that Upper Palaeolithic humans adorned their clothing and bodies elaborately, placing great importance on their appearance. Discoveries such as the female figurine from Hohle Fels help to demonstrate how Aurignacian people used ornaments to represent themselves and their world symbolically while conveying stories, social positioning and status through these adornments. This holds true for the whole Upper Palaeolithic of southwestern Germany.

**Acknowledgements**

We especially thank Ewa Dutkiewicz, Susanne C. Münzel and Marian Vanhaeren for their input concerning the content of this manuscript. We appreciate the kind invitation to the conference by Olaf Jöris, Harald Meller, Oliver Dietrich and Roberto Risch. Claudia Gärtner was a wonderful host, and we are grateful to Aniela Schuchardt and Florian Michel for the support of publishing this chapter. We also thank the hundreds of excavators, who have contributed to the excavations in the caves of the Swabian Jura.

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## Source of figures

1 C. Sommer, ROCEEH; map base: site coordinates after M. Malina, G. Toniato, and the ROAD Database; elevation from SRTM V3; hydrological Network from LUBW; country boundaries in the inlet are from Natural Earth; the Font is Open Sans; doi:10.5281/zenodo.3460300, CC-BY 4.0 licence
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# Possible visual impacts of double perforated ivory beads found in the Swabian Aurignacian

Shuqin Guo, Stefanie Kölbl, Marian Vanhaeren, Sibylle Wolf, and Nicholas J. Conard

**Zusammenfassung**

Mögliche visuelle Effekte von doppelt durchlochten Elfenbeinperlen aus dem Schwäbischen Aurignacien

*Doppelt durchlochte Perlen aus Elfenbein (DPIBs) sind ein wesentliches Element des Schmucks im Schwäbischen Aurignacien und zeichnen sich durch ihre geringe Größe, ihre einzigartige Form und die zwei Perforationen aus. Trotz ihrer im Vergleich zu anderen Schmuckformen hohen Zahl bleibt die Art und Weise, wie sie als Perlen getragen wurden, ungewiss. In dieser Studie werden die verschiedenen Möglichkeiten des Arrangierens von DPIBs anhand der Analyse von 74 archäologischen Objekten aus der Höhle Hohle Fels, Alb-Donau-Kreis, experimentellen Nachbildungen und Online-Recherchen zu modernen Perlenarbeitstechniken untersucht. Die Ergebnisse deuten darauf hin, dass das Auffädeln und nicht das Nähen die plausibelste Befestigungsmethode war, die auch mit den beobachteten Abnutzungsmustern übereinstimmt. Experimentelle und moderne Perlarbeiten lassen darauf schließen, dass DPIBs komplexe dreidimensionale Perlenstrukturen gebildet haben könnten, die sowohl dekorativen als auch praktischen Zwecken dienten. Diese Studie verdeutlicht die Raffinesse des frühen symbolischen Ausdrucks sowie der Handwerkskunst und unterstreicht das Potenzial der Kombination von archäologischen Analysen mit experimentellen Ansätzen und Vergleichen mit heutigen Perlarbeiten zum Verständnis der visuellen Kultur des Paläolithikums.*

**Schlagwörter** Schmuckstücke, Hohle Fels, Perlarbeit, Morphometrie, Handwerkskunst

**Summary**

*Double perforated ivory beads (DPIBs) represent an essential element of personal ornaments in the Swabian Aurignacian, notable for their small size, unique shape, and the two perforations. Despite their prevalence, the way in which they were worn as beads remains uncertain. This study investigates the methods of assembly of DPIBs through the analysis of 74 archaeological specimens from Hohle Fels Cave, Alb-Donau-Kreis District, experimental replication, and online research into modern beadwork techniques. The findings indicate that stringing, rather than sewing, is the most plausible method of use in accordance with observed wear patterns. Experimental and modern beadwork suggest that DPIBs could have formed complex three-dimensional beadwork structures, serving both decorative and practical roles. This study highlights the sophistication of early symbolic expression and craftsmanship, emphasising the potential of combining archaeological analysis with experimental approaches and modern beadwork to understand Palaeolithic visual culture.*

**Keywords** Personal ornaments, Hohle Fels, beadwork, morphometry, craftsmanship

Double perforated ivory beads (DPIBs) are a prominent feature in the personal ornament assemblages of the Swabian Aurignacian (cf. e.g. Conard 2003; Kölbl/Conard 2003; Wolf 2015). Their extremely small size and distinctive shape have sparked a range of speculations about their function. The sheer number of these beads is intriguing and raises the question: Why two holes when a single one might have sufficed? Unfortunately, DPIBs have not been found in direct association with primary burials, and their method of assembly and wear – possibly sewn onto clothing – remains a subject of speculation.

To explore their likely modes of assembly, a sample of 74 DPIBs from archaeological horizon IV at Hohle Fels Cave, Alb-Donau-Kreis District, was analysed. In addition, replica DPIBs were produced, assembled, suspended, and worn in experimental setups. An online search was also conducted to identify possible linking techniques for other types of beads with two perforations.

Analysis of the archaeological material reveals that DPIBs varied in size, e.g. ranging between 5.9 and 10.6 mm in length (mean is 7.8, SD is 1.2), and were shaped into a distinctive pinched-oval form with two perforations separated by a curved central ridge.

Experimental results suggest that threading across the thick ridge between the holes offers little practical value. Suspension experiments – testing both loosely and tightly

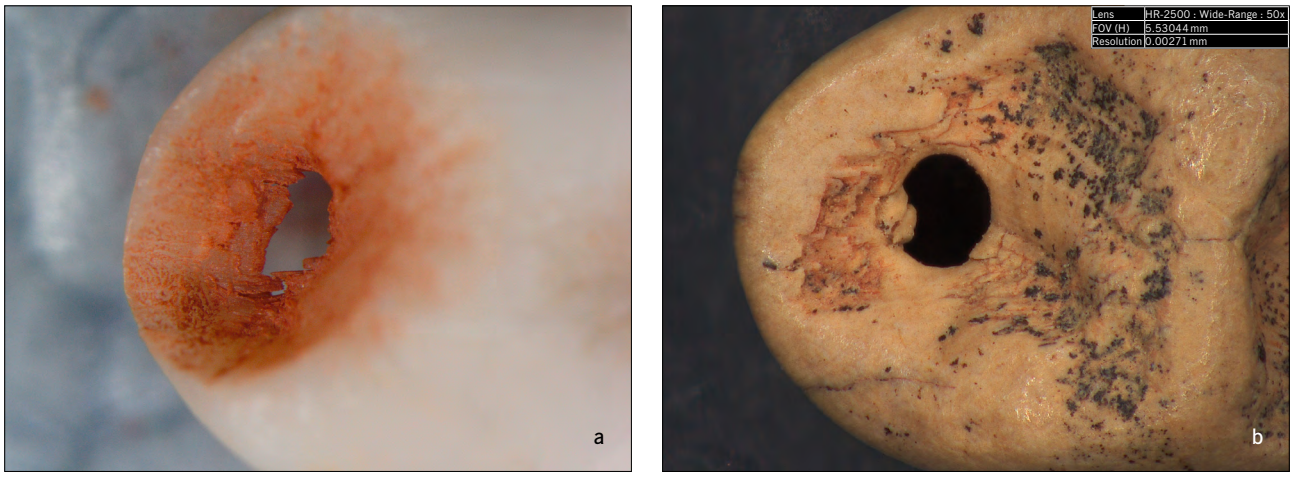


**Fig. 1a–b** Comparable fish scale patterns found on archaeological and replicated double perforated ivory beads. a Fish scale pattern around the perforation of a double perforated ivory bead replica worn experimentally on a sieve shaker (item strung vertically on a sinew string and processed for 120 minutes on a Retsch AS 400 with a speed set to rpm/g: 200); b fish scale pattern on an archaeological double perforated ivory bead (item number 55-1668.1 from Hohle Fels Cave, Alb Donau Kreis District, archaeological horizon IV).

***Abb. 1a–b*** *Das vergleichbare Fischschuppenmuster auf archäologischen und nachgebildeten doppelt durchlochten Elfenbeinperlen. a Fischschuppenmuster auf einer doppelt durchlochten Perlreplik aus Elfenbein, die experimentell getragen wurde (vertikal auf einer Sehne aufgereiht für 120 Minuten mit einer Retsch AS 400 Siebmaschine mit einer Drehzahl von rpm/g: 200); b Fischschuppenmuster auf einer archäologischen doppelt durchlochten Perle aus Elfenbein (Nr. 55-1668.1, aus dem archäologischen Horizont IV der Höhle Hohle Fels, Alb-Donau-Kreis).*

strung, as well as sewn replicas – produced only minimal modification of the perforations. These findings suggest that the characteristic fish-scale wear patterns observed around the perforations in archaeological items are more consistent with stringing than with sewing (Fig. 1).

The online query, based primarily on Google searches for keywords, images, and videos, as well as the results of the 2018 beadwork competition hosted by the Museum of Prehistory in Blaubeuren, yielded additional insights. A search for ›two-hole bead‹ reveals that such beads are commonly known among modern bead workers. The online material surveyed provided an enormous variety of beadwork patterns. A closer look at these patterns reveals key insights into their visual and structural properties:

**Fig. 2** String of beads made from dried berries with double perforated ivory bead replicas used as spacers; no scale.

***Abb. 2*** *Perlenkette aus getrockneten Beeren mit Nachbildungen von doppelt durchlochten Elfenbeinperlen als Abstandshalter; o. M.*

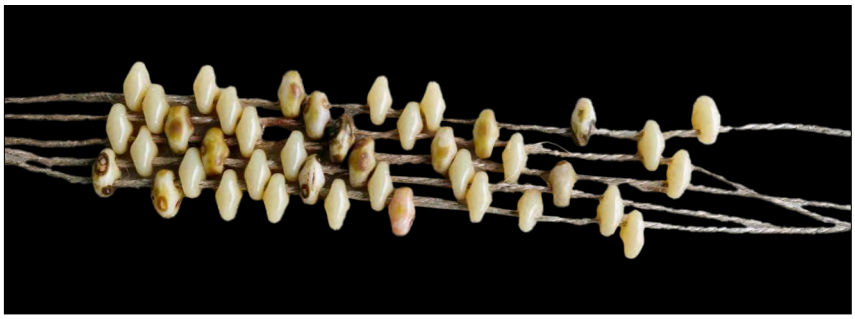

**Fig. 3** Production of a solid band by stringing double perforated ivory bead replicas; no scale.

***Abb. 3*** *Herstellung eines festen Bandes durch Aneinanderreihen von Nachbildungen doppelt durchlochter Elfenbeinperlen; o. M.*

1. The unique shape allows such beads to nest neatly together.
2. They can be connected to form flat sturdy bands.
3. They are often and easily used in combination with other bead types.
4. Three-dimensional beadwork patterns are possible and can be quite complex.

The artwork produced by participants in the Blaubeuren competition shows strong parallels with modern beadwork techniques seen online. One participant, for instance, used replicated DPIBs as bead spacers to separate and anchor different strands of beads (Fig. 2). In this context, the curved ridge between the holes helps to keep two strands distinct while providing a smooth connection to adjacent beads or decorative elements. Another participant expanded on this idea by assembling several DPIBs into a solid band (Fig. 3), which not only creates a visually striking pattern but could also offer some protection for the wearer's skin or body. One competitor used DPIBs in a zipper-like configuration (Fig. 4), enabling the joining of two leather parts. This setup could have been used to gather fabric into folds or make clothing more adjustable for different body shapes and sizes.

In summary, the results suggest that the use of DPIBs in beadwork is potentially very sophisticated. These beads can serve not only as simple decorative elements strung together but also as components of complex three-dimensionally-patterned structures. Moreover, modern beadwork often involves combining double perforated beads with other bead types. Future experimental research should aim to identify diagnostic features that can distinguish specific DPIB beadwork patterns. Such insights may provide a deeper understanding of Aurignacian visual expression and concepts of beauty.

## Acknowledgements

Our thanks go to the editors of the Proceedings of the 17th Archaeological Conference of Central Germany, ›A Stone Age History of Clothing‹, for offering us the opportunity to share our research. We thank Johannes Wiedmann for generously providing carved ivory beads, Rudolf Walter for offering suggestions on the replication experiments, and Bernhard Röck and Louis Corrigan for providing mammoth ivory to replicate DPIBs. We appreciate that the University of Applied Forest Sciences Rottenburg, Germany (specifically Andrej Bösiger, Christina Zwanger, and Rainer Kirchhof) let us use their sieve shaker. We are grateful to the participants of the bead competition in the Museum of Prehistory in Blaubeuren. This research benefited from the bilateral French-German Procope program (French Partenariat Hubert Curien [PHC] 2024 Project no. 50971QG – German Academic Exchange Service [DAAD] 2024 Project no. 57705111).

**Fig. 4** Double perforated ivory bead replicas sewn on leather to fulfil the function of a zipper in the middle and to create decorative patterns (left and right); no scale.

***Abb. 4*** *Nachbildungen von doppelt durchlochten Perlen aus Elfenbein, die auf Leder genäht wurden. Sie erfüllen die Funktion eines Verschlusses in der Mitte und erzeugen dekorative Muster an den Seiten (links und rechts); o. M.*

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# A Late Magdalenian ›coat of many colours‹? A new look at well-worn evidence from the sites Gönnersdorf and Andernach-Martinsberg (Germany)

Martin Street and Elaine Turner

**Zusammenfassung**

Ein spätmagdalénienzeitlicher »Vielfarbenmantel«? Ein neuer Blick auf altbekannte Funde von den Fundplätzen Gönnersdorf und Andernach-Martinsberg (Deutschland)

*Die spätmagdalénienzeitlichen Fundplätze von Gönnersdorf, Lkr. Neuwied, und Andernach-Martinsberg, Lkr. Mayen-Koblenz, haben einen äußerst reichhaltigen und vielfältigen archäologischen Materialcorpus hervorgebracht, der Einblicke in die wirtschaftlichen und sozialen Lebensweisen des späten Magdaléniens gewährt.*

*Der ökologische Kontext der spätpleistozänen Fundstellen ist eine Landschaft, die gemeinhin als »Mammutsteppe« bezeichnet wird, die von Pferden, Rentieren, Polarfüchsen und anderen eiszeitlichen Arten, einschließlich der namensgebenden Spezies, geprägt ist. Es liegt auf der Hand, dass die Bewohner von Gönnersdorf und Andernach-Martinsberg zum Überleben in dieser Umgebung nicht nur über effektive Jagdwaffen sowie als Witterungsschutz über kälteangepasste Behausungen verfügen mussten, sondern auch über äußerst durchdachte Bekleidung. In diesem Beitrag werden mögliche Nachweise für Kleidung aus den beiden Fundplätzen untersucht. Dabei wird ein ganzheitlicher Ansatz verfolgt, der sich auf das Vorhandensein zahlreicher Materialgruppen und die Anwendung mehrerer Analysestrategien stützt.*

**Schlagwörter** Magdalénien, Kleidung, Zooarchäologie, Gebrauchsspurenanalyse, Symbolik

**Summary**

*The Late Magdalenian sites of Gönnersdorf, Neuwied District, and Andernach-Martinsberg, Mayen-Koblenz District (Germany), have produced an extremely rich and diverse corpus of archaeological material, providing insights into late Magdalenian economic and social lifeways.*

*The ecological context of the late Pleistocene sites is a landscape characterised by horse, reindeer, arctic fox, and other Ice Age species including the eponymous species of what is commonly referred to as the ›mammoth-steppe‹. Clearly, survival in this environment would require the inhabitants of Gönnersdorf and Andernach-Martinsberg to possess not only effective hunting weapons and the shelter of cold-adapted dwellings but also extremely sophisticated clothing. This paper examines potential evidence for clothing from the two sites, taking a holistic approach and drawing on the presence of numerous material categories and the application of several analytical strategies.*

**Keywords** Magdalenian, clothing, zooarchaeology, traceology, symbolism

## 1. Location, context and chronology

The Late Magdalenian sites of Gönnersdorf, Neuwied District, and Andernach-Martinsberg, Mayen-Koblenz District, are located in the Rhine Valley close to the northern edge of the Central European upland zone. Until the very end of the Magdalenian, the transition between this and the North European Plain represented the northern limit of the late glacial humanly occupied world. The two exceptionally similar sites lie on opposite sides of the Rhine, only 2 km apart and within clear line of sight of each other, where the river exits the wide Neuwied Basin and flows to the northwest, re-entering the narrow Rhine gorge.

Targeted radiocarbon sampling of hunted mammal remains (Street/Terberger 2004; Stevens et al. 2009) dates the main Magdalenian occupations at Gönnersdorf and Andernach-Martinsberg to around 15 600 cal BP (uncalibrated ~ 13 000 BP). Toward the end of the late glacial Allerød interstadial both sites were buried under thick ash and pumice deposits erupted by the Laacher See Volcano (van den Bogaard/Schmincke 1985; Baales et al. 2002), leading to their exceptional conservation in comparison with unprotected contemporary terrestrial localities.

## 2. Characterisation of the sites, paving and pits, bone preservation

The Martinsberg site was uncovered by pumice quarrying on the outskirts of the town of Andernach in the late

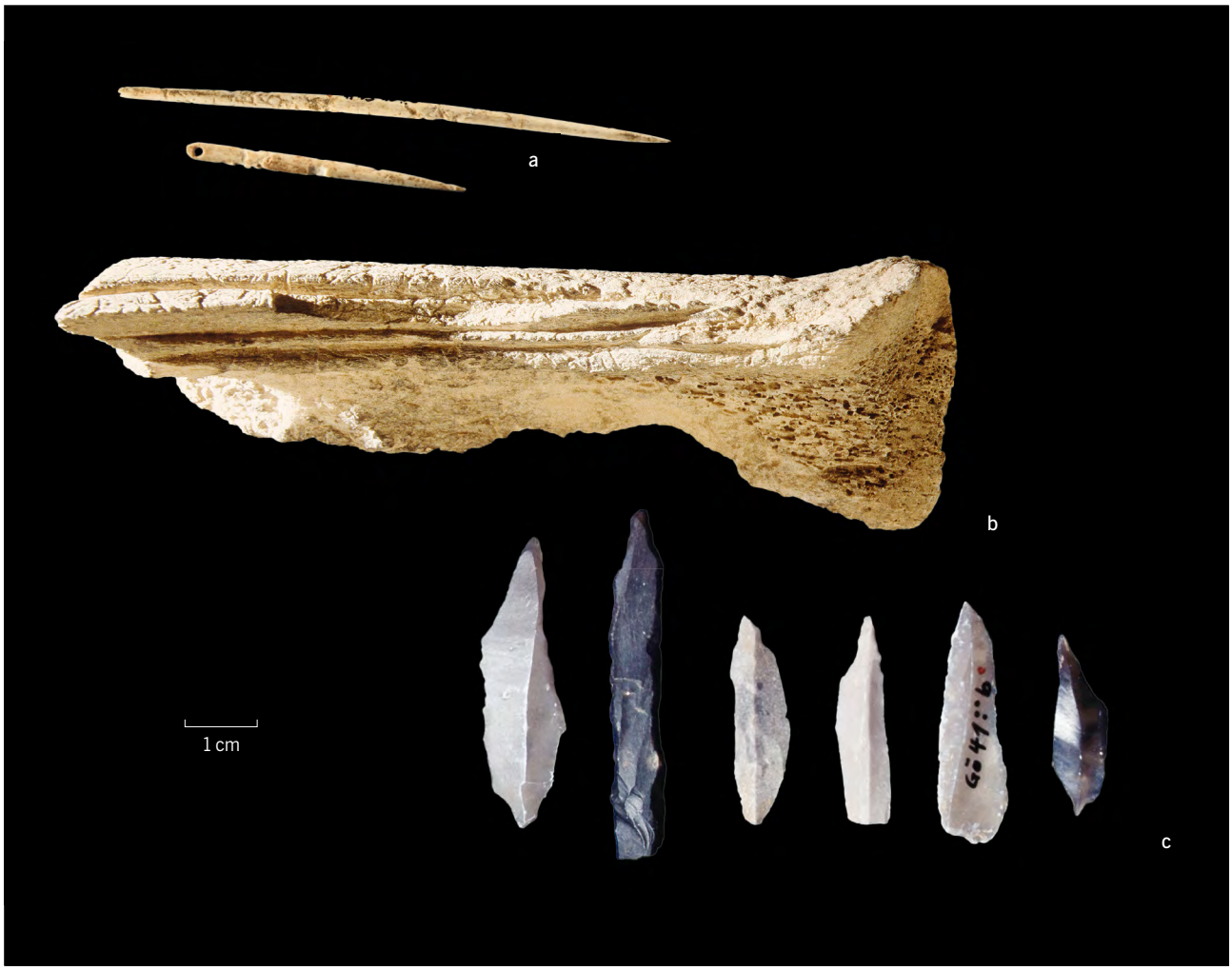


**Fig. 1a–c** The Magdalenian sewing-kit. a Bone eyed-needles from Andernach-Martinsberg, Mayen-Koblenz District (with intact eye), and Gönnersdorf, Neuwied District; b needle core on a horse *metatarsus* (Andernach-Martinsberg); c piercers of flint (Gönnersdorf).

***Abb. 1a–c*** *Das magdalénienzeitliche Nähkästchen. a Knochennadeln mit Öhr aus Andernach-Martinsberg, Lkr. Mayen-Koblenz (mit intaktem Öhr), und Gönnersdorf, Lkr. Neuwied; b Nadelkern an einem* Metatarsus *vom Pferd (Andernach-Martinsberg); c Bohrer aus Feuerstein (Gönnersdorf).*

19th century; results of the 1883 excavation by H. Schaaffhausen were published soon afterwards (Schaaffhausen 1888). The exact position of the site was subsequently forgotten as the town expanded during the 20th century. It was rediscovered during building development (Veil 1978; Veil 1979) and excavated from 1979–1983 (Veil 1982; Veil 1984). Construction of new housing led to excavations at the site from 1994–1996 (Bergmann/Holzkämper 2002). In 2006, what will probably be the final investigations were undertaken at the now completely built-over site (Krahl/Maier 2020).

Gönnersdorf was discovered in 1968 during the excavation of deep foundations for new housing in the suburbs of the town of Neuwied. Until 1976, the site was investigated over a surface of approximately 700 m² during several annual campaigns of excavation that revealed some of the most complex late Upper Palaeolithic settlement structures in western Central Europe (Bosinski 1979).

Both sites are characterised by several spatially distinct large and dense concentrations of archaeological material (Bosinski 1979; Eickhoff 1995). Their rich assemblages of lithic and faunal materials are associated with standardised structural features, often interpreted as ›roofed‹ dwellings. These may include complex placements of large slabs and blocks of slate, quartzite, basalt and other rocks, and areas of ochre-staining. The structures were too large to be transportable. They remained permanently in place and were occupied and modified on repeated occasions, probably over several years (Terberger 1997).

The structures are normally associated with numbers of pits deliberately dug into the underlying sediment. The original functions of these pits are unknown. They may have had a construction function (as post holes), served as boiling pits (with heated cobbles), hearths, for storage or deposition. During their subsequent infilling, the pits served as sediment traps for the incorporation and optimal preservation of adjacent smaller-sized archaeological objects. This is particularly important in the case of less robust categories of organic material that are particularly susceptible to weathering, e.g. bird and rodent bone, elements of adornment such as teeth and fossil shell, or – particularly relevant here – finely worked bone needles.

## 3. Potential evidence for clothing

### Bone needles

At both Gönnersdorf and Andernach, the most compelling evidence for the presence and, indeed, the production of sewn clothing are eyed needles made of bone (Fig. 1a) and, far less commonly, antler or ivory (Tinnes 1994; Street/Turner 2013). That such needles were certainly produced at the sites is shown by several cores left by their manufacture (Fig. 1b). As befits these sites where subsistence was dominated by horse hunting, the preferred materials used as cores for needle manufacture were this species' dense, straight metacarpal and metatarsal bones. Very rarely, reindeer antler and mammoth ivory were also used for needles. Twelve of the Gönnersdorf needles were identified by J. Tinnes (1994) as antler, and two specimens are described as ivory or possibly ivory. Bone elements of other species, such as reindeer metapodials, hare tibias or bird limb bones that were also used to produce needles during the Magdalenian (e.g. Berke 1987) are almost entirely absent at the two Rhineland sites, where only one fragment from Gönnersdorf might possibly be a bird bone (Tinnes 1994, 58).

Bone weathering and corrosion have visibly damaged many surviving needles and certainly will have destroyed many of those originally present. Surface weathering sometimes makes their recognition difficult; while other analysts might regard some previously identified specimens as questionable, further specimens were recognised by new examination of the smaller bone fragments.

Almost all needles from both sites were recovered in a fragmentary state. Proximal fragments are identified by their eye, usually broken but in some cases still intact or recognisably unfinished. Tubes sawn from lengths of hollow bird bone are sometimes speculated to have functioned as ›needle cases‹ (e.g. Tinnes 1994).

### Awls and piercers

If the finer-eyed needles of bone perhaps seem too delicate to penetrate tough animal hides or skin, other possibilities exist. Conceivably the needles were used to pull thread through holes pre-bored by more robust awls of bone or antler, or by the fine-tipped piercers of flint present at both sites (Fig. 1c).

### Sinew, cordage and fibres

Analysis of the Magdalenian bone assemblages identified cut marks on horse phalanges, which are interpreted as the result of obtaining ligaments located on these body parts (cf. Parkin et al. 1986). These could have been used for twisting into thread or cord and, indeed, O. Soffer described a Gönnersdorf antler fragment bearing an impression thought to have been due to contact with a twisted cord (Soffer et al. 2000). Theoretically, plant materials such as grasses or bark/bast might also have been twisted or plaited into cordage. No evidence for these materials survives, but the mammoth steppe would have provided a great range of resources, including bushes and some hardy species of tree that grew in sheltered locations with sufficient water supply, such as the Rhine Valley.

### Hides, furs and fabric

The convex working edges of numerous end-scrapers show heavy wear and rounding, interpreted as the result of their intensive use in hide working (Plisson 2002; Vaughan 2002; Sano 2012). Some of the Magdalenian structures are characterised by zones of staining by red ochre (haematite), a mineral that can be used in hide processing and is often found on scraper working ends, perhaps due to this practice.

Were the worked hides, skins and pelts intended for clothing, blankets, tent coverings – or all of these? The faunal assemblages at Gönnersdorf and Andernach derive from the hunting and exploitation of several species of large (horse, reindeer) and medium-sized (fox, hare) mammals and birds, while the ›bestiary‹ (Poplin 1976) preserved by depictions engraved on slate slabs (Bosinski/Fischer 1980; Bosinski 1996; Bosinski 2008a) shows the Magdalenians' familiarity with the much broader spectrum of contemporary animals available to provide a wide range of exploitable resources. From robust horse hide to well-cured reindeer buckskin and insulating pelts of arctic fox and blue hare, there would have been no problem with access to raw materials suitable for producing various items of clothing. Analogy with modern-day circumpolar Indigenous peoples can provide inspiration here – for example, recognising the superior insulating properties of wolverine fur, or adapting skin from the legs of reindeer to make watertight boots for humans. Without a doubt, the pelts of arctic fox and blue hare were attractive: they turn white in the winter, a season at which both sites were occupied, and there is evidence of skinning on the bones of both species at Gönnersdorf (Street/Turner 2013). For other – now lost – resources, we must use our imagination: the dense underfur and long, tough guard hairs revealed by frozen mammoth carcasses would surely have provided materials for insulation and perhaps thread or cordage.

### Rondelle

Rondelle are sub-circular discs of locally available slate (Fig. 2a), worked into this shape by percussion around their edges and finished by an approximately centrally located hole typically drilled from both sides of the disc (Bosinski 1977). While their purpose is still unknown, and some commentators have seen them as purely decorative[1], they may have had a functional use. In combination with cords and

1 Some discs are engraved (Fig. 2b), and single specimens of antler and ivory (Fig. 2c) are known at Gönnersdorf.

**Fig. 2a–c** Perforated discs (›rondelles‹) from Gönnersdorf. a Slate rondelles of varying size (not to scale); b slate rondelle with aligned triangular engraving (vulva?); c rondelles made of organic materials (a mammoth ivory; b–c reindeer antler).

***Abb. 2a–c*** *Gelochte Scheiben (»Rondelle«) aus Gönnersdorf. a Schieferrondelle unterschiedlicher Größe (nicht maßstabsgetreu); b Schieferrondelle mit ausgerichteter dreieckiger Gravur (Vulva?); c Rondelle aus organischen Materialien (a Mammut-Elfenbein; b–c Rentiergeweih).*

pegs of wood, bone or antler they could have served as a form of fastening – perhaps for tents or clothing?

## Adornment and decoration

Accepting the premise that complex and cold-adapted Magdalenian clothing existed, and taking inspiration from the much more abundant indirect evidence for clothing recognised in Middle Upper Palaeolithic burials, we can examine the Gönnersdorf and Andernach assemblages for indicators of how the application of decorative elements or items of personal adornment might have modified Magdalenian clothing.

### *Teeth*

The first class of objects identified as personal adornment are the teeth of large and medium-sized mammals modified by perforation for suspension or attachment to cloth-

**Fig. 3a–f** Decorative elements made from perforated and otherwise modified animal teeth. a Perforated arctic fox canine tooth (Andernach-Martinsberg); b perforated premolar teeth of arctic fox (Andernach-Martinsberg); c a complete row of reindeer incisor and canine teeth removed as a unit from the mandible by sawing through the roots (Gönnersdorf); d incisor teeth of wisent or aurochs removed from the mandible by sawing through the roots (Andernach-Martinsberg); e perforated canine teeth of red deer (Gönnersdorf); f engraved and perforated mammoth ivory plaque (Andernach-Martinsberg).

***Abb. 3a–f*** *Dekorative Elemente aus durchlochten und anderweitig bearbeiteten Tierzähnen. a Gelochter Eckzahn eines Polarfuchses (Andernach-Martinsberg); b gelochte Prämolaren des Polarfuchses (Andernach-Martinsberg); c eine komplette Reihe von Rentierschneide und -eckzähnen, die als Einheit aus dem Unterkiefer entfernt wurden, indem die Wurzeln durchgesägt wurden (Gönnersdorf); d Schneidezähne von Wisent oder Auerochse, die durch Durchsägen der Wurzeln aus dem Unterkiefer entfernt wurden (Andernach-Martinsberg); e gelochte Eckzähne von Rothirschen (Gönnersdorf); f gravierte und gelochte Plakette aus Mammutelfenbein (Andernach-Martinsberg).*

ing or other objects. The most common of these are the canine (Fig. 3a), incisor and (pre)molar teeth (Fig. 3b) of arctic fox. This may reflect a greater rate of loss or discard of the smaller fox teeth, or their relative abundance may be an effect of their greater availability. The equivalent teeth of the much larger wolf are, by contrast, very rare; at Gönnersdorf, they comprise only an unperforated canine and eight other teeth. The overall number of remains shows that fox was very commonly hunted, providing numerous teeth, while the few wolf bones and teeth might represent only a couple of pelts.

A different method was used to extract and transform the incisor and canine teeth of reindeer. Only present in the lower jaw, the row of eight adjacent teeth was removed from the mandible by sawing through the roots (Fig. 3c) but leaving them connected by gingival tissue. It is certain that many of the modified reindeer teeth were imported as personal adornments, manufactured elsewhere and not obtained from the relatively few animals butchered at the Rhineland sites.

The same method was used to extract the incisor teeth of aurochs or bison (Fig. 3d). It is still unclear which of the two species is represented. Engravings on slate plaques show that both animals were well known to the Magdalenian inhabitants of the Central Rhineland (Bosinski 2008a), but since postcranial material is rare (Gönnersdorf) or absent (Andernach) it cannot be ruled out that such items were imported over long distances.

Red deer maxillary canine teeth, modified as personal adornments, occur regularly throughout the Upper Palaeolithic and into much younger periods down to the present day. Only a few specimens were found at Gönnersdorf (Fig. 3e) and Andernach; since red deer is not one of the species hunted at the sites during the Magdalenian (Street 1993; Street/Turner 2013) they are possibly exotic imports, analogous to the far-travelled Mediterranean marine mollusc shells also found at both localities (Langley/Street 2013).

Another object which can be included in the category of modified teeth is an ivory artefact recovered at Andernach (Fig. 3f). This object – unique for the Magdalenian context – is formed from a thin, flat plaque of ivory detached from a mammoth tusk. Today its surface is weathered by corrosion and traversed by lines etched by plant roots, but originally it must have been smooth, polished, and white in appearance. Four artificial perforations are preserved adjacent to, or on, the four edges. J. Tinnes (1994) interprets the piece as only half of an originally quadratic object, in which case the larger object would have had one central perforation and, if symmetrical, six peripheral holes. This suggests a function as a decorative item, perhaps stitched to clothing.

#### *Shell, jet and ivory*

A second category of personal adornment based on animal remains comprises marine gastropod and scaphopod molluscs. *Homalopoma sanguineum* is a species of small marine gastropod mollusc, today native to the Mediterranean. The shells have a naturally reddish colour (Fig. 4a), presumably an important feature underlying their attractiveness and value for personal adornment. This is underlined by their presence in the Rhineland, far from their point of origin. The red colour contrasts with the white appearance of the associated shells of scaphopods such as *Dentalium* (Fig. 4b). Almost all the modified mollusc shells (*H. sanguineum*, *Dentalium vulgare* and *dentale*, *Cyclope neriteus*) at Andernach were recovered from Concentration II, a well-defined area of the site associated with numerous flint burins, resharpening spalls, and mammoth ivory debitage. 46 specimens of *H. sanguineum* and a single *Cyclope neriteus* were recovered from a single feature interpreted as a pit, which might indicate that they were strung together when perhaps lost or deliberately deposited (Street 1993).

A third variation of ornament is found only at Gönnersdorf, where beads have been manufactured using black jet (Fig. 4c). Some of these beads even seem to imitate the shape of red deer maxillary canine teeth, providing a jet-black counterpart (Fig. 4d) to the yellowish-white pendants of animal origin. Possibly also to be seen in this context is a small piece of ivory carved with parallel notches (Fig. 4e) interpreted as imitating a length of fossil crinoid (sea lily) stem (Bosinski 2008b). Taken together, these three variants of perforated beads suggest the possibility of a juxtaposition of red, black and white elements.

### Feathers

We have previously argued (Street/Turner 2016) that the various species of birds at Gönnersdorf and Andernach represented not only a food resource but also fulfilled further roles at the sites. We suggested deliberate selection for species with white or pale plumage – swan and goose, and at Gönnersdorf snowy owl and gull – whose wings were possibly introduced to the sites as disarticulated units. They could have served as raw material for bone tools or musical instruments, provided useful pinion feathers, or been used for their decorative or potentially ritual value. The white winter plumage of ptarmigan/willow grouse would complement that of the larger species, and the relatively numerous wing bones might indicate the selection or curation of wings or even entire skins following consumption of the meat. Raven is also found at both sites, and there are plausible arguments that it was primarily valued not as food but for its skin, with jet-black plumage and claws still attached.

We speculated whether the juxtaposition of black and white feathers at Gönnersdorf and Andernach was solely for aesthetic reasons or possibly went beyond this, taking on significance in the symbolic conventions of the time. An iconic symbol of the Late Magdalenian, the abstract and headless female figurines defined as the ›Gönnersdorf type‹ (Höck 1993), can be executed in different materials such as jet and slate, or ivory and antler, which might also reflect a deliberate polarization of black and white imagery. The occurrence of both black and white female imagery, taken together with the availability of multiple materials that could transfer this imagery into actual clothing, seems worthy of consideration in the context of the present paper.

**Fig. 4a–e** Decorative elements of shell and jet/lignite. a Perforated shells of the Mediterranean marine gastropod *Homalopoma sanguineum* (Andernach-Martinsberg); b shells of scaphopods and (top row centre) a fossil belemnite (Gönnersdorf); c perforated beads of jet/lignite (Gönnersdorf); d perforated pieces of jet/lignite, possibly in imitation of perforated canines of red deer canine teeth (Gönnersdorf); e carved piece of mammoth ivory from Gönnersdorf (below) interpreted as a possible imitation of a fossil crinoid (above).

***Abb. 4a–e*** *Dekorative Elemente aus Muscheln und Gagat/Lignit. a Gelochte Gehäuse der mediterranen Meeresschnecke* Homalopoma sanguineum *(Andernach-Martinsberg); b Gehäuse von Skaphopoden und (obere Reihe Mitte) ein fossiler Belemnit (Gönnersdorf); c gelochte Perlen aus Gagat/Lignit (Gönnersdorf); d gelochte Stücke aus Gagat/Lignit, möglicherweise in Nachahmung der gelochten Eckzähne von Rothirschen (Gönnersdorf); e geschnitztes Stück Mammutelfenbein aus Gönnersdorf (unten), das als mögliche Nachahmung eines fossilen Seelilienstengels interpretiert wird (oben).*

## Engravings

The Late Magdalenian female image was also recorded in engraved depictions (Bosinski et al. 2001), which are highly abstracted and normally only represented by an outline. However, an engraved slate plaque from Gönnersdorf depicting four stylised female figures (Fig. 5), one of whom is carrying a smaller figure interpreted as a baby or child, might be a potential source of information for the appearance of Magdalenian clothing (Bosinski/Fischer 1974). Unusually, in this engraving, the interiors of all the figures are filled with a complex series of lines and hatching. It seems possible that this is not simple abstraction or merely done to emphasize the figures but is indeed intended to portray the actual appearance of the persons represented by the engraved figures – whether as a depiction of body ornament or clothing. If the latter, it is noteworthy that the design entirely covers the depicted women's bodies – and even the baby – from the neck to the knees. There are, nevertheless, differences of detail. The baby (Fig. 5b,4) and the smallest of

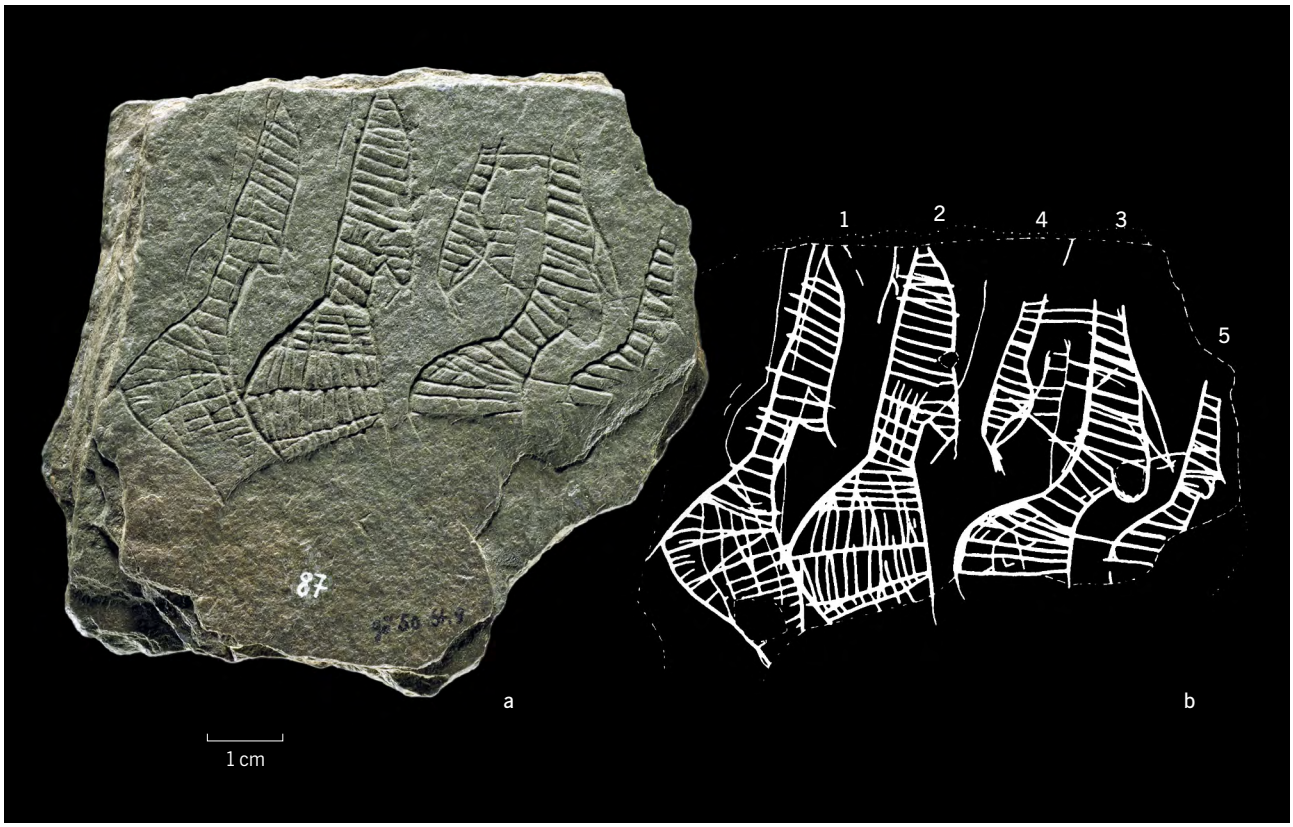


**Fig. 5a–b** Stylised engravings of humans possibly depict elements of clothing (Gönnersdorf). a The deeply engraved plaque shows four clearly female figures (b,1–3.5) facing to the right and a smaller figure (b,4) being carried; b a drawing of the plaque reveals details of the crossing lines and hatching within the outlines of the figures.

***Abb. 5a–b*** *Stilisierte Gravuren von Menschen stellen möglicherweise Elemente von Kleidung dar (Gönnersdorf). a Die tief eingravierte Platte zeigt vier eindeutig weibliche Figuren (b,1–3.5), die nach rechts blicken und eine kleinere Figur (b,4), die getragen wird; b die Umzeichnung der Tafel verdeutlicht Details der sich kreuzenden Linien und Schraffuren innerhalb der Umrisse der Figuren.*

the four female figures at the right (Fig. 5b,5) have the simplest design consisting only of horizontal lines. The figure carrying the baby (Fig. 5b,3) has more complex lines around the hips and the buttocks. The most complex patterns are seen on the two figures at left (Fig. 5b,1–2), each of whom has an individual style.

## 4. Discussion

The rich and diverse corpus of archaeological material from the sites of Gönnersdorf and Andernach provides several lines of evidence relevant to the discussion of clothing during the late Magdalenian. A complex and standardised toolkit for the working and cutting of hides and their transformation into clothing comprised scrapers and sharp-edged lithic artefacts, awls and piercers made of stone and organic materials, and eyed needles for sewing. The appearance of late Magdalenian clothing at Gönnersdorf and Andernach remains unknown. The numerous highly abstract depictions of female figures offer almost no evidence for clothing; we have, however, described a rare potential exception above.

A logical first consideration might be the colour of the clothing. Clearly, any mammal pelts or feathered bird skins used for clothing would preserve their original colour scheme. For several animal species found at our sites, these would have been highly contrasting black and white elements. In the case of skins worked into leather – whether more or less supple depending on species and method of preparation – the use of ochre would probably introduce a red element to the palette of available colours. Without a doubt, yellows and browns of mineral origin (such as the ubiquitous loess) and similarly coloured organic elements, such as dried grasses, were also available.

To expand on this, we can emphasise the wide variety of organic and inorganic materials suitable as decoration for clothing, whatever form this took. Significantly, many of the decorative elements duplicate the colours suggested as likely for the clothing itself. Red, black and white beads, black and white plumage, and trimmings of white fur could have been stitched onto clothing, suspended as pendants, or attached as threaded elements, potentially determining the aesthetics of the clothing of the time. Other factors such as the perceived value of the various items (due to rarity?), any symbolism associated with the objects or their colours, and certainly the societal status of the person wearing the clothing would have been the crucial factors determining exactly who could dress in which way.

## Acknowledgements

We would like to thank Olaf Jöris for inviting us to contribute to this volume. Our thanks also go to Nicole Viehöver (Monrepos) for preparing the figures. Especial thanks are due to Aniela Schuchardt and two reviewers, whose detailed and constructive comments have contributed to make this a much better paper.

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# Neolithic clothing discoveries of the Alpine Region. Waterlogged finds from submerged and glacial sites

Albert Hafner

**Zusammenfassung**

Neolithische Kleidungsfunde aus dem Alpenraum. Feuchtbodenfunde aus Seeufersiedlungen und glazialen Fundstellen

*Textilien aus archäologischen Befunden wurden erstmals Mitte des 19. Jhs. in Europa in alpinen Seeufersiedlungen entdeckt. Ihre bemerkenswerte Erhaltung machte sie zu sensationellen Funden. Es handelt sich bei den meisten Textilien um kleine Fragmente, aber auch größere Kleidungsstücke wie Umhänge wurden entdeckt. Die Eisfunde in der hochalpinen Zone der Alpen bieten sogar noch bessere Erhaltungsvoraussetzungen als die bereits hervorragenden Bedingungen in Seeufersiedlungen. Zu den bemerkenswerten europäischen Funden gehören die Eismumie vom Tisenjoch in Italien und die Funde vom Schnidejoch in der Schweiz, wo Schuhe, Kleidung und Kopfbedeckungen gefunden wurden. In den Seeufersiedlungen haben nur Stoffe aus pflanzlichen Materialien überlebt, während Leder im Eis Tausende von Jahren erhalten geblieben ist. Das Material aus Feuchtbodenfundstellen liefert direkte physische Belege für Stoffe und Kleidung aus prähistorischer Zeit. Diese außergewöhnliche Erhaltung ermöglicht die Anwendung moderner Analysemethoden, die Aufschluss über die Herkunft und Art der verwendeten pflanzlichen Rohstoffe wie Baumbast, Leinen und andere Fasern geben. Darüber hinaus können paläogenetische und chemische Analysen von Leder die Genome der genutzten Tiere und die verwendeten Gerbtechniken aufdecken. Diese Übersicht gibt einen Überblick über die neolithischen Textilfunde aus den Seeufersiedlungen der Alpenregion (5000–2500 v. Chr.), die seit 2011 zum UNESCO-Weltkulturerbe gehören, sowie über die Bekleidungsfunde aus zwei alpinen Eisfundstellen aus der Zeit zwischen dem 4. und 3. Jt. v. Chr.*

**Schlagwörter** Neolithikum, Feuchtbodenfundstellen, Schweiz, Alpen, alpine Pfahlbauten

**Summary**

*Textiles from archaeological contexts were first discovered in Europe during the mid-19th century, specifically in Alpine lakeside settlements. Their remarkable preservation rendered them sensational finds. While most fabrics are small fragments, larger items of clothing, such as capes, have also been uncovered. Ice sites in the high Alpine zone of the Alps offer even better preservation than the already excellent conditions in lakeshore settlements. Notable European finds include the ice mummy from the Tisenjoch in Italy and discoveries at Schnidejoch in Switzerland, where shoes, clothes, and headdresses have been found. In the lakeside settlements, only fabrics made of plant materials have survived, whereas leather, composed of animal proteins and tannins, has survived in the ice for thousands of years. Material from waterlogged sites provides physical, direct evidence of fabrics and clothing from ancient times. This exceptional preservation allows modern analytical methods to be applied, yielding information about the origin and type of plant raw materials used, such as tree bast, linen, and other fibres. Additionally, paleogenetic and chemical analyses of leather can reveal the genomes of the animals used and the tanning techniques employed. This review provides an overview of the Neolithic textile finds from the lakeside settlements of the Alpine region (5000–2500 BC), recognised as UNESCO World Heritage sites since 2011, and the clothing finds from two Alpine ice sites dating from the turn of the 4th to 3rd millennium BC.*

**Keywords** Neolithic, waterlogged sites, Switzerland, Alps, alpine lake dwellings

## Archaeological sites in the Alpine region containing organic artefacts

In general, woven fabrics and leather finds are an extremely rare category in the archaeological context. Prehistoric clothes are made either from plant fibres or from keratin fibres of animal origin. Leather is the tanned dermis of animals. All these materials are of organic origin. However, like all organic materials, fabrics and leathers decompose rapidly in the archaeological context and only survive under exceptional conditions. Archaeological finds of textiles and leather are preserved either in completely dry or in fully water-saturated environments. Preservation in ice is a special form of water-saturated conservation. Examples of par-

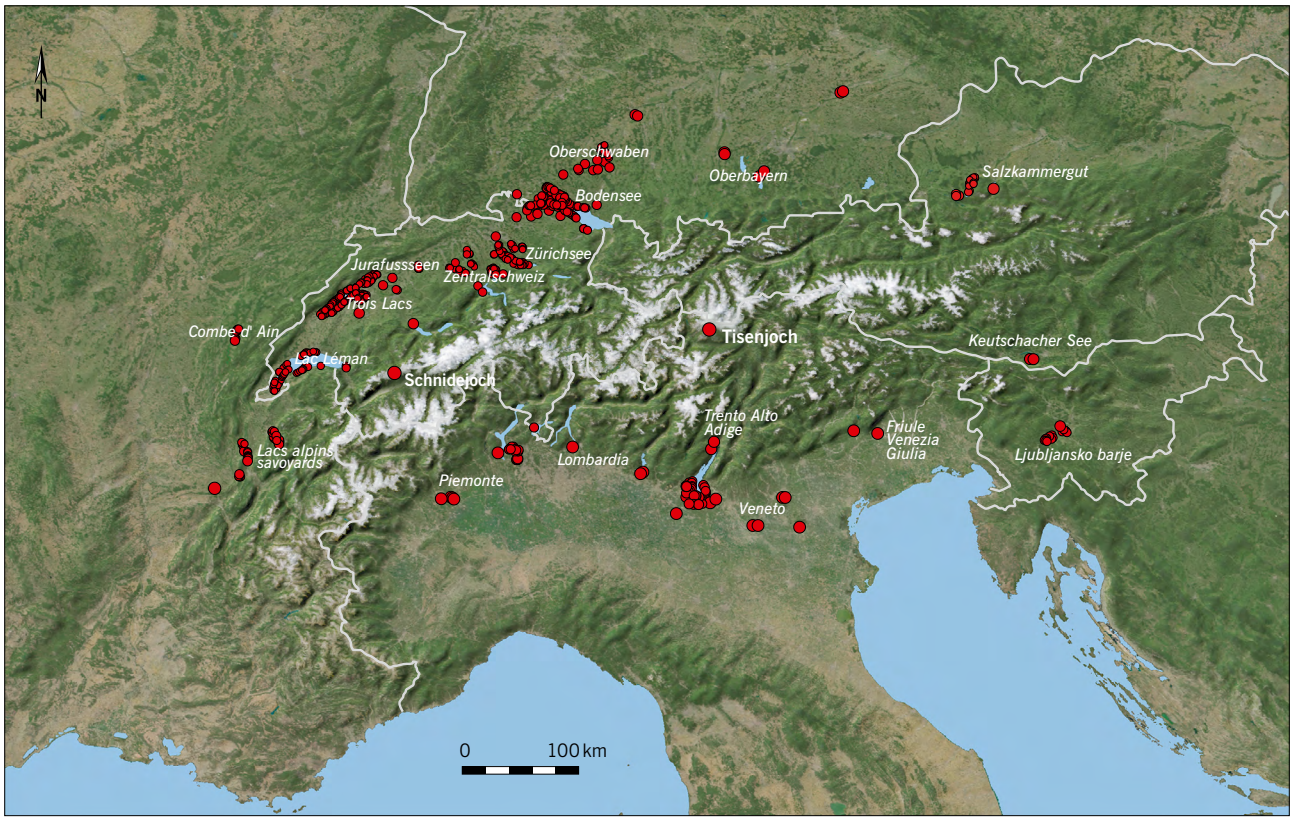


**Fig. 1** Archaeological sites containing organic finds of the Alpine region. Prehistoric lake shore settlements in the Alpine foothills (5000–800 BC) and the high-Alpine ice-patch sites of Tisenjoch (Ötztal Alps, Italy) and Schnidejoch (Bernese Alps, Switzerland).

***Abb. 1*** *Archäologische Fundstellen mit organischen Funden in der Alpenregion. Prähistorische Seeufersiedlungen im Alpenvorland (5000–800 v. Chr.) und die hochalpinen Fundstätten Tisenjoch (Ötztaler Alpen, Italien) und Schnidejoch (Berner Alpen, Schweiz).*

ticularly dry climates that allow the preservation of prehistoric textiles can be found at archaeological sites in deserts or high-altitude regions, mostly in the context of burials or sacrificial sites. Notable examples include Pharaonic tomb complexes in Egypt (Vogelsang-Eastwood 1993), prehistoric cemeteries in the Turfan Depression and the Tarim Basin of the Uygur Autonomous Region of Xinjiang (China; Beck et al. 2014; Kramell et al. 2014), as well as pre-Columbian cemeteries of the Tarapacá region in the Atacama Desert of Chile (Sepúlveda et al. 2021) and human sacrifices on high-altitude mountain peaks of the Andes (Reinhard 2005). A rare form of dry conservation involves the presence of salt. In prehistoric Eurasia, such conditions are notably met in salt mines (Grömer et al. 2013; Barber 2024). For a complete picture, the preservation of textile and leather remains through corrosion of metal objects in the direct vicinity should also be mentioned (Grömer 2016).

In the European Alpine region, organic material is preserved in two types of archaeological sites (Fig. 1). Waterlogged sediments in lakes and wetlands of the Alpine foothills (including former, now silted-over lakes) provide ideal conditions for the preservation of plant-based organic material such as wood, bark, fibres, seeds, and fruits. Animal protein-based organic materials, such as leather, hides, hair, fingernails and horn, do not preserve in these conditions. In contrast, all these materials have a high preservation potential in Alpine glacial sites.

Prehistoric lakeshore settlements, or ›pile dwellings‹, from the Neolithic and Bronze Age periods (5000–800 BC) have been known in the Alpine region for over 170 years and have been the subject of intensive research ever since (Fig. 2). Approximately 1000 settlement areas, most of them with multiple settlement phases, have been identified. However, their spatial distribution is uneven: around 880 are located north of the Alps, while about 120 are on the southern side. The highest concentration is found between Lake Geneva and Lake Constance, with Switzerland's Three-Lake Region (Lake Biel, Lake Murten, and Lake Neuchâtel) alone containing over 200 sites. The oldest settlements on the southern side of the Alps date back to 5000 BC, with Bronze Age sites particularly common in this region. In contrast, Neolithic settlements (4300–2500 BC) dominate north of the Alps. The study of these sites began in the mid-19th century, with F. Keller's publication *›Die keltischen Pfahlbauten in den Schweizerseen‹* (Keller 1854) marking the formal start of European lake settlement archaeology. Since 2011, the ›Prehistoric Pile Dwellings around the Alps‹ have been recognised as a transnational UNESCO World Heritage site (Hafner 2012b; Hafner 2013). The discovery of Alpine pile dwellings was a pivotal moment in European settlement archaeology. When excavated, these exceptionally well-preserved sites yield a comprehensive range of artefacts, along with structural remains such as buildings, palisades, and pathways.

**Fig. 2a–b** Archaeological sites containing organic finds of the Alpine region. Around 1000 Neolithic and Bronze Age lake shore settlements form an extensive group of waterlogged sites, which are characterised by the exceptionally good preservation of wood and plant fibres, including fibres for clothing. a Excavation Zug-Riedmatt; b underwater excavation Lake Biel, Canton of Bern (Switzerland).

***Abb. 2a–b*** *Archäologische Feuchtbodenfundstellen mit Erhaltung von organischem Fundmaterial in der Alpenregion. Rund 1000 neolithische und bronzezeitliche Seeufersiedlungen bilden eine umfangreiche Gruppe, die sich durch die außergewöhnlich gute Erhaltung von Holz- und Pflanzenfasern, einschließlich Fasern für Kleidung, auszeichnen. a Ausgrabung Zug-Riedmatt; b Unterwassergrabung Bielersee, Kanton Bern (Schweiz).*

**Fig. 3** Archaeological sites containing organic finds of the Alpine region. Numerous examples of leather clothing have been found at two well-known high-Alpine ice-patch sites. Pictured: find situation at Lenk, Schnidejoch, Bernese Alps (Switzerland), 2750 m above sea level (picture taken in 2005).

***Abb. 3*** *Archäologische Fundstellen mit organischen Funden in der Alpenregion. Auf zwei bekannten hochalpinen Fundplätzen aus dem Eis wurden zahlreiche Beispiele für Lederbekleidung gefunden. Im Bild: Fundlage an der Lenk, Schnidejoch, Berner Alpen (Schweiz), 2750 m über dem Meeresspiegel (Aufnahme von 2005).*

Notably, dendrochronology allows for remarkably precise dating, often down to the exact year.

In contrast, glacial sites in the Alpine region represent a relatively recent source of archaeological discovery (Fig. 3). The first prehistoric finds from a high-altitude ice patch were made in 1991 on the Italian side of the Ötztal Alps. The discovery of human remains, clothing, and personal equipment from the ›Iceman‹ of Tisenjoch, South Tyrol (Italy), more than 30 years ago marked the beginning of global glacial archaeology (Dixon et al. 2014). The individual, who died violently around 5300 years ago at an altitude of over 3300 m above sea level, is considered one of the most significant finds of prehistory. Due to global warming, Alpine glaciers and small ice fields are increasingly revealing more artefacts. Since 2003, and up until recently, around 900 objects from the period between 4800 BC and 1200 AD have been uncovered from a melting ice patch at Schnidejoch, a high-altitude mountain pass in the Bernese Alps of Switzerland, some 2750 m above sea level (Hafner 2012a; Hafner 2015). Both high Alpine sites share the fact that they have yielded exceptional clothing and equipment made from organic materials, items that had never been discovered before and were excellently preserved over millennia in the ice. For the preservation of fragile organic materials and human remains, it is crucial that they are embedded in flat, small ice patches with stagnant ice. Individuals or objects that fall into crevasses of large glaciers are destroyed by the downward movement of the ice and the powerful forces at play there. The oldest finds from ›flowing‹ glaciers are typically no more than a few decades or centuries old, while archaeological organic objects from stagnant ice can be preserved in perfect condition for thousands of years.

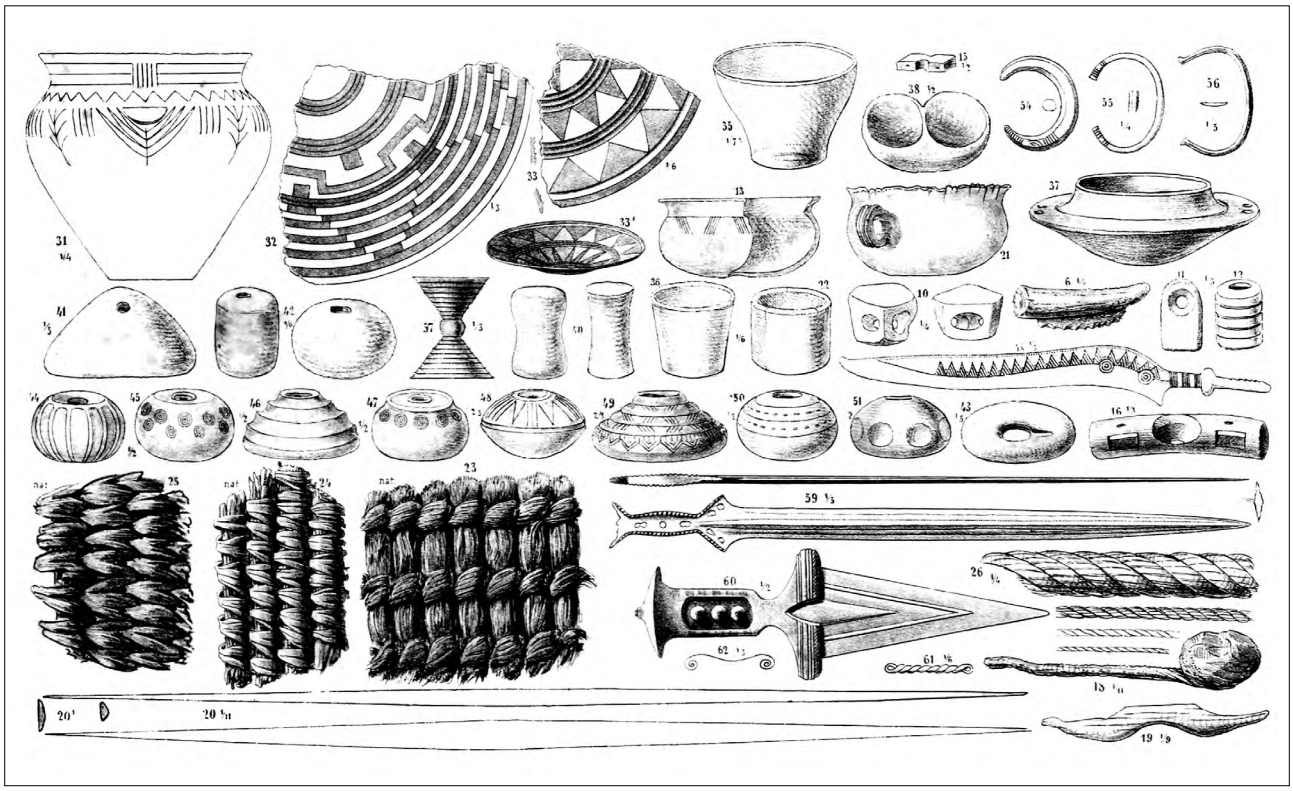

**Fig. 4** First (1858) illustration of plaited mats from the lakeshore settlement of Wangen on Lake Constance, Constance District (Germany).

***Abb. 4*** *Frühe (1858) Abbildung von geflochtenen Matten aus der Seeufersiedlung von Wangen am Bodensee, Lkr. Konstanz (Deutschland).*

## Woven and plaited fabrics from waterlogged sites in lakes and bogs

The first reports of the discovery of woven fabrics from prehistoric lake dwellings were published by F. Keller in the second and fourth pile dwelling reports of 1858 and 1861, respectively (Fig. 4–5; Keller 1861). Shortly thereafter, these findings were disseminated to a wider audience through publications aimed at education and teacher training (Fig. 6; Staub 1864). In the late 19th century, plaited and woven items, including those from private excavations by the Swiss farmer J. Messikommer, such as from Wetzikon-Robenhausen, Canton of Zurich (Altorfer 2010), were sold as scientific souvenirs and curiosities to European tourists. These items found their way, often through indirect routes, into numerous museums around the world (Fig. 7). Textiles from prehistoric, waterlogged pile-dwelling sites were previously unknown in Europe and worldwide. Due to their rarity, they became highly sought-after and prized additions to both private and museum collections, ultimately becoming ›the measure of all things‹ (Banck-Burgess 2019). In the era of Evolutionism, they were seen as evidence of humanity's early craftsmanship. The fragility of the woven fabrics discovered posed significant challenges, especially when they needed to be studied or displayed in museums. As a result, early finds were stored between glass plates, often sealed with various adhesives, making them nearly impossible to open today. The first comprehensive study of the woven and braided fabrics and mats from Neolithic and Bronze Age lake settlements in Switzerland was published in the 1930s (Vogt 1937). In recent years, compilations on plant fibres and fabrics from lakeside settlements, synthesising the material, were published, emphasising the significance of these finds for prehistoric research (Médard 2010; Rast-Eicher 2015; Karg 2025).

The presence of hackle teeth and combs, spinning whorls, balls of yarn and loom weights in Neolithic find complexes provides clear evidence of fibre processing, thread production, and loom use (Fig. 8–11). This stage of textile production is therefore well-documented. The two concentrations of a total of over 40 loom weights in two buildings of the Neolithic settlement at Sutz-Lattrigen, Rütte, Lake Biel, Canton of Bern (Switzerland), dating to around 2700 BC, allow the reconstruction of nearly 2-metre-wide looms (Suter 2017). This suggests that these looms were used to weave fabrics over 1.0 to 1.5 m in width. On the other hand, while hundreds of woven fabric fragments have been discovered, complete garments are entirely absent (Fig. 12). The fineness and tight weave of the fabrics suggest that they were most likely intended for use in clothing, rendering alternative applications such as carpets or curtains unlikely. The existing finds do not allow for a conclusive reconstruction of the clothing worn by Neolithic populations of the Alpine region. As a result, we lack even a partial understanding of the crucial production steps that followed fabric making or the final appearance of their garments. Moreover, leather clothing from lakeshore settlements has not survived at all. One of the few larger objects found, made of tree bast and linen, is a cloak from Lüscherz on Lake Biel, Canton of Bern (Switzerland), dating to around 3600 BC (Fig. 13; Rast Eicher in Hafner/Suter 2005).

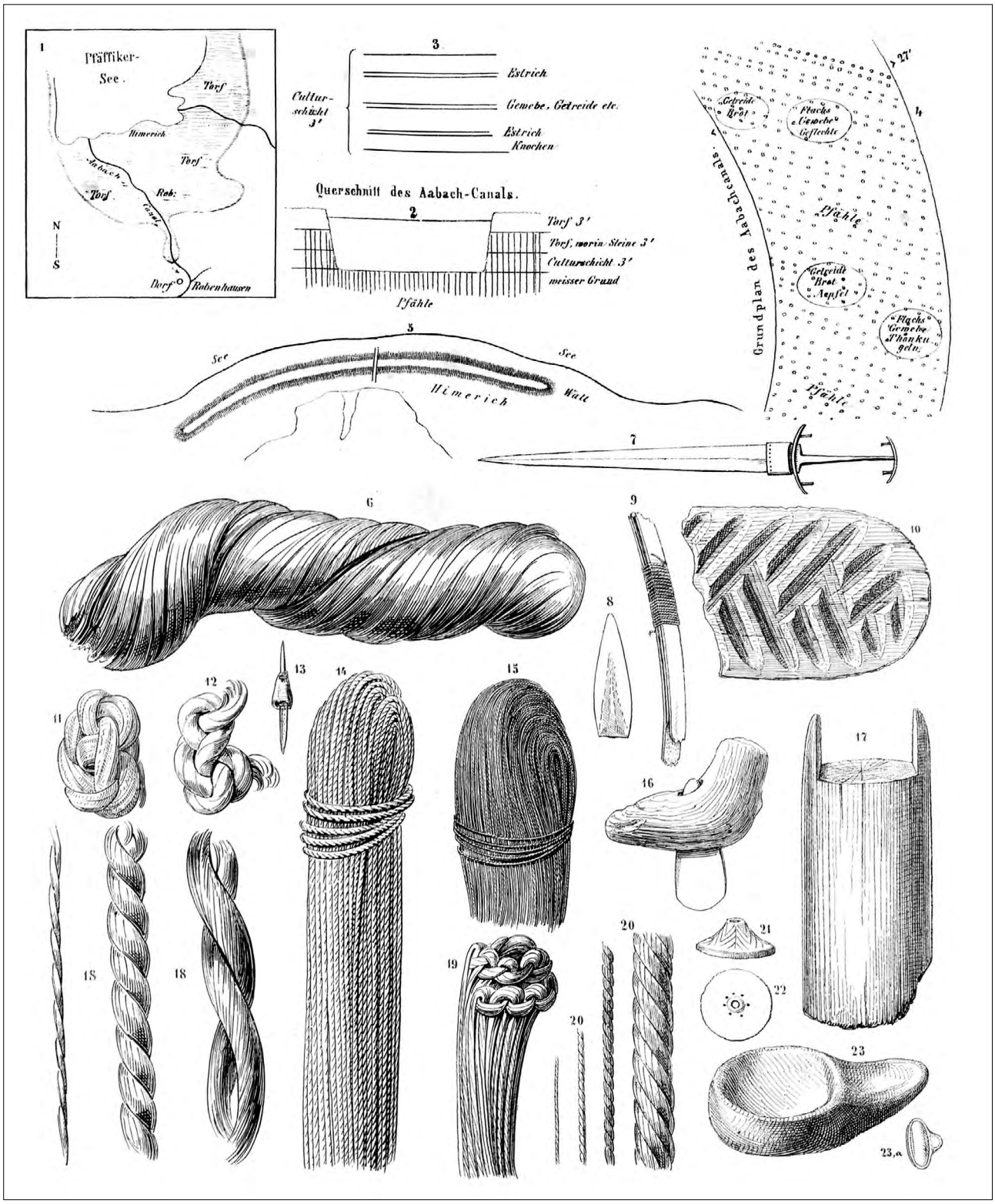


**Fig. 5** ›*Fäden, Schnüre, Seile*‹ (threads, cords, ropes) from the lake shore settlement of Wetzikon-Robenhausen, Canton of Zurich (Switzerland).

***Abb. 5*** *»Fäden, Schnüre, Seile« aus der Seeufersiedlung von Wetzikon-Robenhausen, Kanton Zürich (Schweiz).*

## Leather clothing from alpine ice-patch sites

The sensational 1991 discovery of an ice mummy at Tisenjoch – a high-altitude pass at 3210 m above sea level in the Ötztal Alps, straddling the Austria-Italy border – captivated global attention. Today, the Tyrolean Iceman stands as the most extensively studied prehistoric human body (Nerlich et al. 2021; Zink/Maixner 2019; Keller et al. 2012). However, his remarkably well-preserved remains, belonging to a man who was around 45 years old when he met a violent end

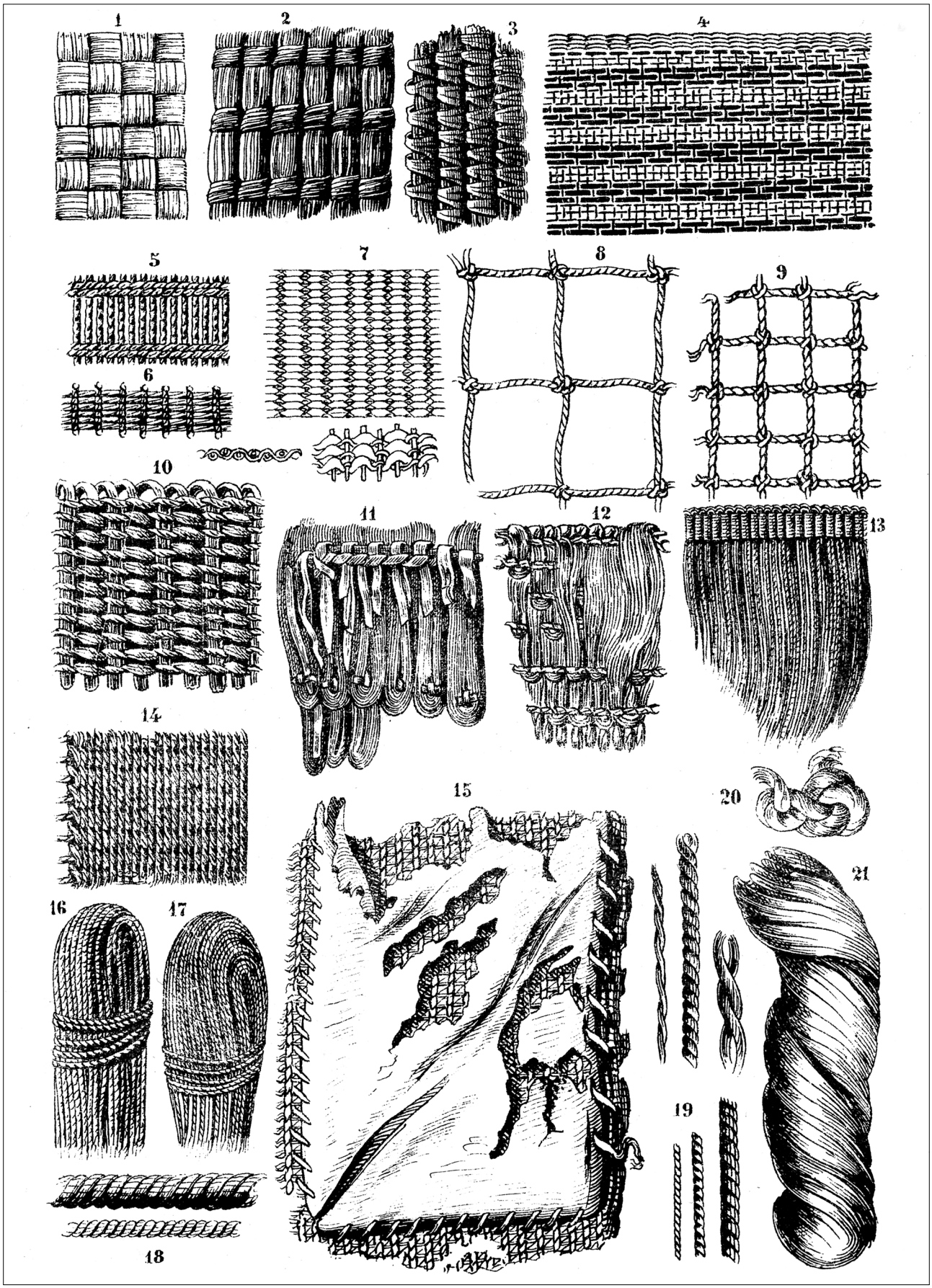


**Fig. 6** ›*Gespinnste, Geflechte, Gewebe*‹ (spun yarns, braids, fabrics). Comprehensive educational guide to Swiss pile dwellings for schoolteachers with a collection of woven fabrics and plaits.

***Abb. 6*** *»Gespinnste, Geflechte, Gewebe«. Umfassendes Lehrbuch der Schweizer Pfahlbauten für Schullehrer mit einer Sammlung von gewebten Stoffen und Geflechten.*

**Fig. 7** Various fragments of cords, fabrics, and plaits, most probably from excavations by the farmer and archaeologist J. Messikommer (1828–1917) at the site of Wetzikon-Robenhausen, Canton of Zurich (Switzerland). They are now in the State Historical Museum, Moscow, and were probably purchased by Russian travellers before 1918.

***Abb. 7*** *Verschiedene Fragmente von Schnüren, Geweben und Zöpfen, die wahrscheinlich von Ausgrabungen des Landwirts und Archäologen J. Messikommer (1828–1917) an der Fundstelle Wetzikon-Robenhausen, Kanton Zürich (Schweiz), stammen. Sie befinden sich heute im Staatlichen Historischen Museum, Moskau, und wurden wahrscheinlich von russischen Reisenden vor 1918 erworben.*

5300 years ago, are only part of the significance of this find. Equally valuable are the numerous clothing items and the equipment recovered alongside him, providing an unprecedented glimpse into the life and appearance of a Neolithic Alpine mountaineer (Egg/Spindler 2009; Wierer et al. 2018).

Since the European heatwave of 2003 and continuing until recently, the retreating ice field at the Schnidejoch site in the Bernese Alps of Switzerland has revealed numerous prehistoric artefacts (Fig. 14)[1]. Like Tisenjoch, Schnidejoch is a high-altitude pass, situated at 2756 m above sea level. The oldest objects date back some 6800 years, while the most recent finds originate from the 12th to 14th centuries AD. In contrast to the Tisenjoch Alpine crossing, where a single historical event – the violent death of a man – is documented by material remains, the discoveries at the Schnidejoch pass reflect a 6000-year history of travel and mobility, likely linked to alpine pastoralism, spanning from the Neolithic period to the Middle Ages. The cooler climatic conditions at the onset of the Little Ice Age in the 14th century caused the surrounding glaciers to advance, effectively blocking the Schnidejoch crossing, which had been in use since the climatic optimum of the Middle Holocene (Grosjean et al. 2007).

Around 600 years after the Tisenjoch incident, another individual may have perished at Schnidejoch around 2800 BC (Hafner 2015). This consideration is supported by the discovery of a complete set of archery equipment, including a yew bow, bowstring, bow case, and numerous arrows, all of which have been radiocarbon-dated to the same period. Additionally, items of clothing such as a grass cape, leather leggings, and leather shoes were found (Fig. 15–17). It is unlikely that such valuable equipment would have been abandoned in the high mountains without necessity or that someone would have willingly removed their clothing in such a harsh environment. However, despite extensive searches, no human remains have been found. Unlike the Tisenjoch site, which lies away from the immediate pass, the discoveries at Schnidejoch were made directly within the narrow passage defined by the surrounding rock faces. This suggests that a body may have been quickly recovered

1 Gubler et al. 2024; Hafner 2015; Hafner/Schwörer 2018; Hafner 2012a.

**Fig. 8** Spindle whorls from various Neolithic lakeshore settlements on Lake Biel, Canton of Bern (Switzerland), made from clay/ceramic (top), stone (middle), and antler (bottom).

***Abb. 8*** *Spinnwirtel aus verschiedenen neolithischen Seeufersiedlungen am Bielersee, Kanton Bern (Schweiz), aus Ton/Keramik (oben), Stein (Mitte) und Geweih (unten).*

**Fig. 9** Hackle comb made from bovine rib bones, with remnants of a cord indicating its original bast wrapping from Nidau-BKW, Lake Biel, Canton of Bern (Switzerland; c. 3400 BC).

***Abb. 9*** *Hechelkamm aus Rinderrippenknochen, mit Resten einer Schnur, die auf eine ursprüngliche Bastumwicklung hinweist, aus Nidau-BKW, Bielersee, Kanton Bern (Schweiz; ca. 3400 v. Chr.).*

after a fatal event while the equipment was left behind, possibly deemed taboo or unusable. At the time, a collective megalithic burial site existed with the two dolmens M XII and M VI of Sion, Petit Chasseur in Valais, located south of Schnidejoch (Favre/Mottet 2011; Gallay/Chaix 1984). It is conceivable that an individual who died at Schnidejoch was laid to rest there. If one accepts the hypothesis that fatal events occurred at both Tisenjoch and Schnidejoch, then these sites together provide two distinct ensembles of clothing and equipment from the Alpine region, dating to the period 3400–2800 BC. This era coincides with the numerous lakeshore settlements in Switzerland associated with the ›Horgen‹ and ›Lüscherz‹ ceramic styles, which immediately precede the emergence of the so-called ›Corded Ware‹ ceramic style around 2750/2700 BC. A comparison of the finds from both Alpine sites reveals a remarkably well-preserved collection of clothing, primarily made of leather, which has survived exceptionally in the ice (Fig. 18). Common garments found at both locations include fragments or complete grass cloaks, leather leggings, and leather shoes. The Tisenjoch ensemble is more extensive, also featuring a fur coat, a loincloth, and a bear fur cap, offering an unparalleled glimpse into the attire of Alpine inhabitants during the Late Neolithic. The preservation of leather found in ice is so exceptional that paleogenetic and biochemical methods could be applied successfully. It was possible to determine that the leggings from Schnidejoch were made from the skin of a domestic goat *(Capra hircus)*, belonging to the caprine haplogroup, which is rare in Europe today (Schlumbaum et al. 2010). Paleogenetic analyses of the leather from the Iceman found at Tisenjoch revealed that his coat and loincloth were made from sheepskin, while a shoelace was crafted from cattle leather. His leggings, however, like the one from Schnidejoch, were made from goatskin (O'Sullivan et al. 2016). Recently, leather finds from Tisenjoch were analysed using protein analysis. Two samples from his coat and one from his leggings were identified as originating from sheep, while the upper leather of his moccasins was made from cattle (Hollemeyer et al. 2008). There is a contradiction in the identification of the leather used for the leggings from Tisenjoch; however, the biochemical analysis does not completely rule out goat as a possibility.

## Neolithic clothing of the Alpine space: what we know

The hunter-gatherer societies of late Pleistocene Central Europe inhabited a treeless tundra landscape where no

**Fig. 10** Examples of loom weights from the Neolithic site of Sutz-Lattrigen, Rütte, Lake Biel, Canton of Bern (Switzerland; 2700 BC). The discovery of two clusters, each containing 22 loom weights, suggests the use of looms approximately 2 m wide, enabling the production of broad fabric strips.

***Abb. 10*** *Beispiele für Webgewichte aus der neolithischen Fundstätte von Sutz-Lattrigen, Rütte, Bielersee, Kanton Bern (Schweiz; 2700 v. Chr.). Der Fund von zwei Clustern mit jeweils 22 Webgewichten deutet auf die Verwendung von Webstühlen mit einer Breite von etwa 2 m hin, die die Herstellung breiter Stoffstreifen ermöglichten.*

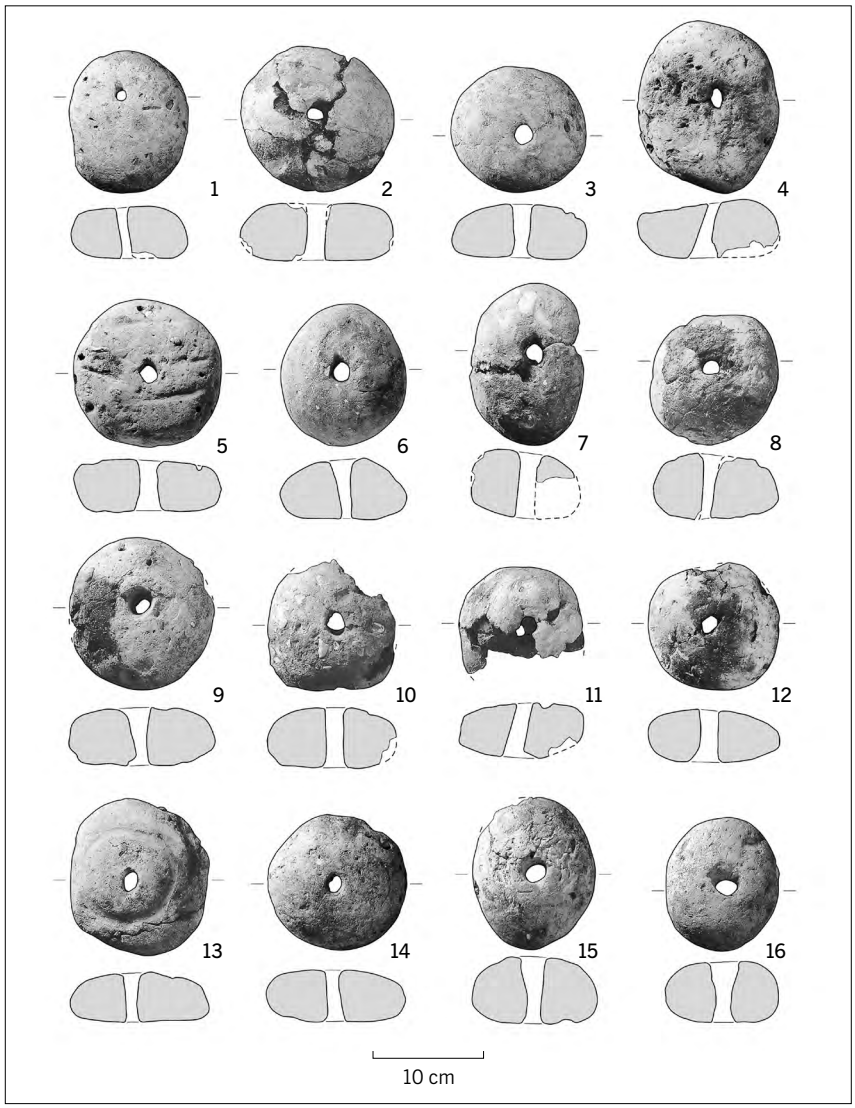

**Fig. 11** Ball of yarn from the Neolithic site of Sutz-Lattrigen, Hauptstation (c. 3200 BC).

***Abb. 11*** *Garnknäuel aus der neolithischen Fundstätte von Sutz-Lattrigen, Hauptstation (ca. 3200 v. Chr.).*

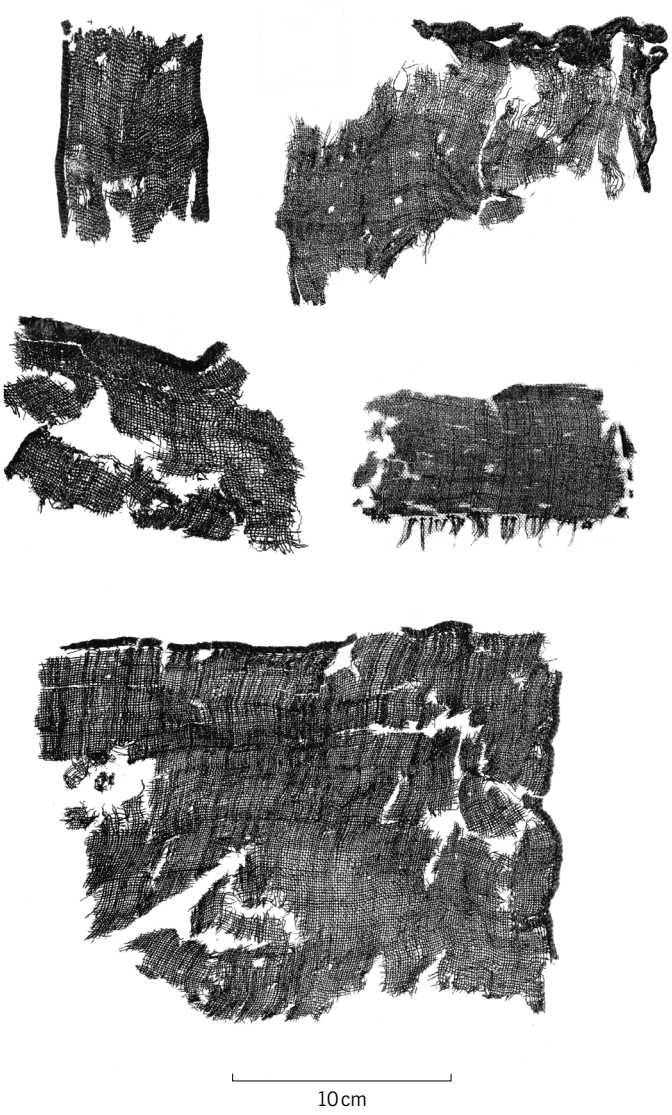


**Fig. 12** Fragments of woven fabrics from the site of Wetzikon-Robenhausen, Canton of Zurich (Switzerland), excavations by J. Messikommer (1828–1917).

***Abb. 12*** *Fragmente von gewebten Stoffen aus der Fundstätte von Wetzikon-Robenhausen, Kanton Zürich (Schweiz), Ausgrabungen von J. Messikommer (1828–1917).*

plant-based materials were available for clothing production. The earliest-known eyed needles, typically used for making leather garments, appear in Europe some 26 000 years ago, whereas they had already emerged in northeast Asia 40 000 years ago (Gilligan et al. 2024). With the mid-Holocene arrival of agriculturally oriented populations to the regions north of the Alps, woven textiles most likely complemented the previously dominant leather clothing but did not replace it completely. In the forested landscapes of Central Europe, various tree species were available for fibre extraction. Lime trees (*Tilia* spp.) were a primary source of bast fibre in prehistoric and, more specifically, Neolithic Europe due to the material's superior quality. Bast materials obviously played a crucial role in early textile production as shown by examples from Neolithic Anatolia (Rast-Eicher et al. 2021). Additionally, the first European farmers cultivated flax (*Linum* sp.), providing another important fibre source for textile manufacturing (Harris 2014). Another key resource for textile production is wool from domesticated sheep. Since the earliest sheep in Central Europe likely had a coat more similar to that of goats, which was not suitable for producing thread or fabric, wool from sheep probably only became significant later in the Central European Neolithic (Becker et al. 2016; Grömer 2010). In any case, regardless of the type of organic material, the preservation of woven fabrics in archaeological contexts is highly challenging, particularly at terrestrial sites without waterlogged conditions. The absence of suitable preservation environments makes it nearly impossible to find direct evidence of textiles (Hafner 2023). Indirect evidence, such as spindle whorls made of stone or ceramics and loom weights crafted from air-dried clay, is commonly found in Central and Western Europe from the 4th millennium BC onward, though isolated discoveries date as far back as the 6th millennium BC. These artefacts confirm that Neolithic farming communities were widely engaged in textile produc-

**Fig. 13** Textile fragment, probably part of a cape, measuring 73 cm in length and made of tree bast and line. Lüscherz, Dorfstation, Lake Biel, Canton of Bern (Switzerland), ›Kettenstoff mit Zwirnbindung‹. The Tyrolean Iceman wore a similar cloak made from sedge (*Carex* sp.).

***Abb. 13*** *Textilfragment, wahrscheinlich Teil eines Umhangs, 73 cm lang, hergestellt aus Baumbast und Leinen. Lüscherz, Dorfstation, Bielersee, Kanton Bern (Schweiz), Kettenstoff mit Zwirnbindung. Der Tiroler Eismann trug einen ähnlichen Umhang aus Segge* (Carex sp.).

**Tab. 1** Clothing Items from Neolithic Alpine lakeshore settlements and ice-patch sites that offer insights into Neolithic clothing in the broadest sense. Garments made of woven fabric have only survived in fragmentary form, making it impossible to determine their original appearance or construction. These textiles were likely worn in combination with leather, possibly serving as undergarments.

***Tab. 1*** *Kleidungsstücke aus neolithischen alpinen Seeufersiedlungen und Eisfeldfundstellen, die Einblicke in die neolithische Bekleidung im weitesten Sinne bieten. Kleidungsstücke aus gewebtem Stoff sind nur fragmentarisch erhalten, sodass ihr ursprüngliches Aussehen und ihre Konstruktion nicht bestimmt werden können. Diese Textilien wurden wahrscheinlich in Kombination mit Leder getragen und dienten möglicherweise als Unterbekleidung.*

| | Leather | Fur | Grass braid | Woven fabric |
|---|---|---|---|---|
| Shoes | • | | • | |
| Leggins | • | | | |
| Loincloth | • | | | |
| Belt | • | | | |
| Coat | • | | • | |
| Headgear | | • | • | |
| Clothing, unspecified | | | | • |

tion. Clay loom weights are only preserved if they undergo secondary firing, for example, in the event of a house fire. Likewise, spindle whorls made from organic materials have very low preservation chances, suggesting a potential bias in the archaeological record (Tab. 1).

Waterlogged settlement sites in lakes and bogs offer the most valuable insights into early textile production. Since the mid-19th century, numerous woven fabrics made from flax (*Linum* sp.) and tree bast have been discovered. Some sites, such as Wetzikon and Robenhausen in the Canton of Zurich (Switzerland) became renowned for their exceptional number of textile finds (Messikommer 1913). These settlements provide comprehensive evidence of the entire production process, from spinning thread with spindle

**Fig. 14** Leggings made of goatskin from Lenk, Schnidejoch, Canton of Bern (Switzerland; 2800 BC; see Fig. 15–16), discovered in 2004 after emerging from the melting ice. Pictured find situation (picture taken in 2005).

***Abb. 14*** *Leggings aus Ziegenleder aus Lenk, Schnidejoch, Kanton Bern (Schweiz; 2800 v. Chr.; vgl. Abb. 15–16), entdeckt 2004 im schmelzenden Eis. Im Bild Fundlage (Aufnahme von 2005).*

**Fig. 15** Leggings made of goatskin from Lenk, Schnidejoch (2800 BC; see Fig. 14 and 16). The inner leg length of the garment measures 85 cm. A nearly identical piece of clothing was also found on the Tyrolean Iceman at Tisenjoch.

***Abb. 15*** *Leggings aus Ziegenleder aus Lenk, Schnidejoch (2800 v. Chr.; vgl. Abb. 14 und 16). Die innere Beinlänge des Kleidungsstücks misst 85 cm. Ein fast identisches Stück wurde auch bei dem Tiroler Mann aus dem Eis am Tisenjoch gefunden.*

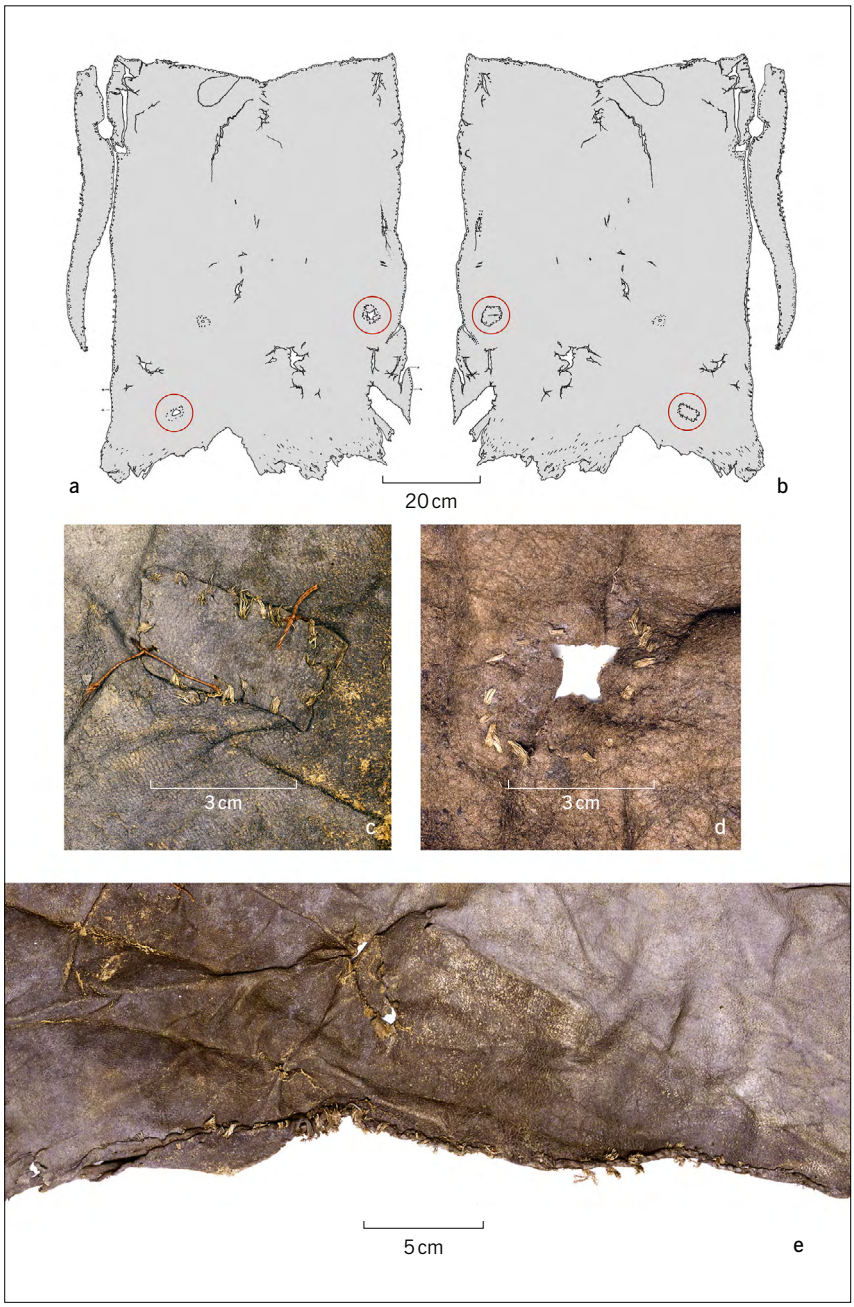


**Fig. 16a–e** Leggings made of goatskin from Lenk, Schnidejoch (2800 BC; see Fig. 14–15), featuring two clearly visible, relatively coarse patch repairs (marked with red circles).

***Abb. 16a–e*** *Leggings aus Ziegenleder aus Lenk, Schnidejoch (2800 v. Chr.; vgl. Abb. 14–15), mit zwei deutlich sichtbaren, relativ groben Flickstellen (markiert mit roten Kreisen).*

whorls to weaving on looms equipped with loom weights. In contrast, leather artefacts are rarely preserved in lake and bog sediments due to unfavourable conditions. However, in glacial environments, leather survives exceptionally well, offering a rare and invaluable glimpse into prehistoric craftsmanship.

From an economic perspective, both textiles and leather – especially those featuring intricate patterns and colours – held significant added value. The entire process of fabric production, from fibre extraction and spinning to weaving, could be carried out almost anywhere. The labour-intensive nature of textile manufacturing enabled the accumulation of valuable goods, making it a significant aspect of early economies. Leather production required not only knowledge of tanning techniques but also considerable manual labour. Many tasks, such as softening hides by chewing them, were highly labour-intensive (Groenman-van Waateringe et al. 1999). Despite these challenges, leatherworking was not limited to regions with fertile soils and favourable agricultural conditions. It remained a viable industry even in more demanding environments, such as the higher elevations of the Alpine region, where hunting likely played a key role in sourcing raw materials. Both woven textiles and leather were undoubtedly highly valued commodities, making them ideal for trade and highlighting their significance in early economies. Examples of garment repair are rare. The woven textile fragments from the lakeshore settlements show no evidence of mending techniques such as darning. In contrast, the two patched areas, featuring sewn-on leather pieces, on the leather leggings from the high-altitude ice site of Schnidejoch clearly indicate that clothing was repaired and considered valuable (cf. Fig. 16).

We know very little about the appearance of prehistoric clothing, as complete garments are rarely preserved.

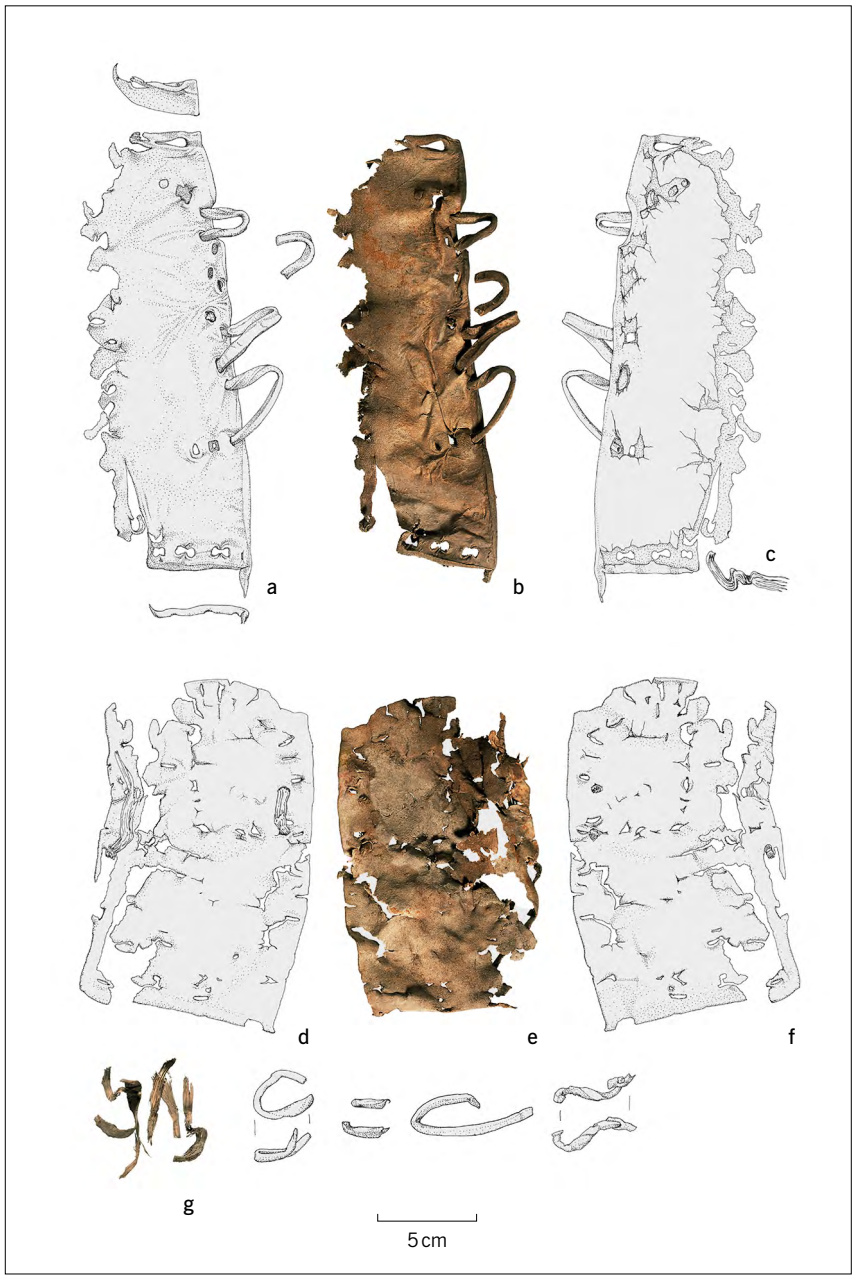


**Fig. 17a–g** Fragments of Neolithic leather shoes, Lenk, Schnidejoch (2800 BC).

***Abb. 17a–g*** *Fragmente von neolithischen Lederschuhen aus Lenk, Schnidejoch (2800 v. Chr.).*

The only significant textile remains come from a few ice-patch sites, where exceptional preservation conditions have allowed for detailed studies. Trousers, in the modern sense, were most probably not known, but a combination of separate leggings and a loincloth seems to have been common. Evidence from the Tyrolean Iceman confirms this type of clothing. Further, his outerwear included a coat-like garment resembling a cape, made from striped pieces of goat and sheep hide stitched together. This long, sleeveless cloak draped over his shoulders was likely wrapped around the body for warmth, and a leather belt helped secure it in place.

We can assume that the clothing of the first farmers in Central Europe was carefully adapted to both weather conditions and environmental factors. During the Mid-Holocene Climatic Optimum, temperatures in the region were warmer than today. In mild weather, many people may have worn nothing more than a loincloth. In colder conditions, they likely dressed in multiple layers of textiles and leather, often incorporating fur for added insulation, as well as leggings and wide cloaks draped around the body for additional warmth.

However, no woven fabric has been found at the high-alpine Neolithic sites of Tisenjoch (Ötzi's discovery site) and Schnidejoch, suggesting that leather may have been the preferred material for clothing in these extreme environments. In contrast, prehistoric lakeshore settlements in the Alpine foothills have yielded numerous fragments of woven textiles, indicating that fabric clothing was also widely used. Looms may have been up to nearly 2 m wide, enabling the production of broad textile panels. Although not yet archaeologically proven, it is likely that patterns and colours also played a significant role in Neolithic clothing. Because garments made of organic material rarely survive the ages, they are completely underestimated in the archaeological, material-based context.

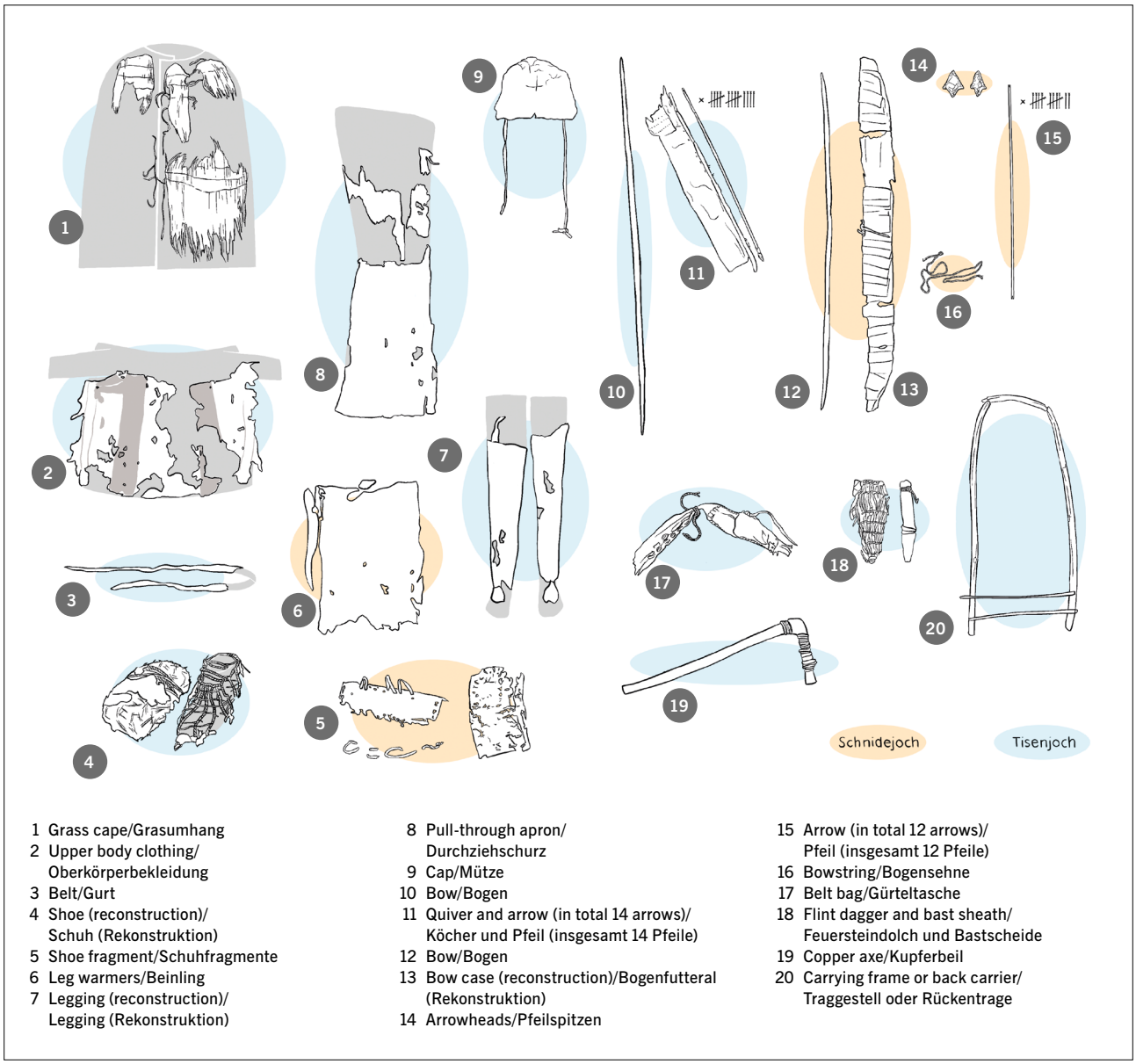
1 Grass cape/Grasumhang
2 Upper body clothing/ Oberkörperbekleidung
3 Belt/Gurt
4 Shoe (reconstruction)/ Schuh (Rekonstruktion)
5 Shoe fragment/Schuhfragmente
6 Leg warmers/Beinling
7 Legging (reconstruction)/ Legging (Rekonstruktion)
8 Pull-through apron/ Durchziehschurz
9 Cap/Mütze
10 Bow/Bogen
11 Quiver and arrow (in total 14 arrows)/ Köcher und Pfeil (insgesamt 14 Pfeile)
12 Bow/Bogen
13 Bow case (reconstruction)/Bogenfutteral (Rekonstruktion)
14 Arrowheads/Pfeilspitzen
15 Arrow (in total 12 arrows)/ Pfeil (insgesamt 12 Pfeile)
16 Bowstring/Bogensehne
17 Belt bag/Gürteltasche
18 Flint dagger and bast sheath/ Feuersteindolch und Bastscheide
19 Copper axe/Kupferbeil
20 Carrying frame or back carrier/ Traggestell oder Rückentrage
Schnidejoch
Tisenjoch

**Fig. 18** Finds of leather clothing and equipment from high-altitude Alpine contexts. The ice mummy from Tisenjoch, Ötztal Alps (Italy), and an individual who likely perished at Schnidejoch, Bernese Alps (Switzerland). The Tisenjoch finds are highlighted in blue, while those from Schnidejoch appear in yellow. Together, they offer a realistic depiction of individuals from 5000 years ago, whose equipment was well adapted to the harsh conditions of the high-alpine mountains.

***Abb. 18*** *Funde von Lederbekleidung und -ausrüstung aus hochalpinen Kontexten. Die Eismumie vom Tisenjoch, Ötztaler Alpen (Italien), und ein Individuum, das wahrscheinlich am Schnidejoch, Berner Alpen (Schweiz), ums Leben kam. Die Funde vom Tisenjoch sind blau hervorgehoben, während die vom Schnidejoch gelb dargestellt sind. Zusammen bieten sie ein realistisches Bild von Individuen vor 5000 Jahren, deren Ausrüstung gut an die rauen Bedingungen der hochalpinen Berge angepasst war.*

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# SEKTION VI: KLEIDUNG UND SOZIALE DIFFERENZIERUNG IN DER STEINZEIT IM SPIEGEL VON GRABBEFUNDEN

# SECTION VI: STONE AGE CLOTHING AND SOCIAL DIFFERENTIATION AS SEEN FROM BURIAL CONTEXTS

Kolorierte Fotomontage der reich ausgestatteten Bestattung (Grab 1) eines erwachsen Mannes (Individuum Sungir' 1) aus Sungir', Oblast Wladimir (Russland; Zeichnung: K. N. Nikahristo, O. N. Bader Archiv, Institut Arkeologii Rossijskoj Akademii Nauk).

*Coloured photo-montage of the richly decorated burial (grave 1) of an adult male individual (Sunghir 1) from the sie of Sunghir, Vladimir Oblast (Russia; drawing: K. N. Nikahristo, O. N. Bader Archive, Institute of Archeology of the Russian Academy of Sciences).*

# Richness and diversity of burial rituals in the Gravettian period: Potential for clothing reconstructions in documentaries

Pauline Coste and Giacomo Giacobini

**Zusammenfassung**

Reichtum und Vielfalt gravettienzeitlicher Bestattungsrituale: ihr Potenzial für Kleidungsrekonstruktionen in Dokumentarfilmen

*Gräber aus dem Gravettien Europas (Mittleres Jungpaläolithikum vor ~34 000 bis 24 000 Jahren) bieten das größte Potenzial für die Rekonstruktion der Kleidung des Jungpaläolithikums. Die Beigaben, die an Körpern in Primärbestattungen (Einzel- oder Mehrfachbestattungen) gefunden wurden, geben einen Eindruck von den regionalen ›Moden‹ oder Traditionen dieser Zeit und von der Vielfalt gravettienzeitlicher Kleidungsstile. Trotz aller Probleme, die an Fragen zur Bekleidung anknüpfen, wenn organische Materialien längst vergangen sind, werden die Daten, die der Reichtum dieser Bestattungen liefert, bei der Rekonstruktion von Menschen in medialen Darstellungen der Vorgeschichte, insbesondere in Dokumentarfilmen, zu wenig genutzt.*

*Die Erstautorin dieses Beitrags, die bei dem 2021 gedrehten Film* Ladies and Princes of Prehistory *für den Fernsehsender Arte (produziert von Enfant Sauvage) Regie geführt hat, wollte diese archäologischen Daten nutzen, um Kostüme für die Reenactment-Szenen des Dokumentarfilms zu erstellen. In diesem Artikel gehen wir auf die Probleme ein, denen wir begegneten, und erläutern die Grundlagen unserer Entscheidungen zur Kostümgestaltung.*

**Schlagwörter** Gravettien, Bestattungen, Ornamente, Reenactment, Dokumentarfilme

**Summary**

*European Gravettian burials (dating to the Mid-Upper Palaeolithic ~34 000 to 24 000 years ago) offer the greatest potential for reconstructing Upper Palaeolithic clothing. The finery found on bodies in primary burials (individual or multiple) gives an idea of the regional ›fashions‹ or traditions of the time and the diversity of clothing styles in the Gravettian period. Despite all the problems posed by the question of clothing whose organic materials have long since disappeared, the data provided by the wealth of these burials are under-utilised in the reconstruction of humans in media presentations of prehistory, particularly in documentaries.*

*The first author, who directed the 2021 film,* Ladies and Princes of Prehistory *for the Arte TV channel (produced by Enfant Sauvage), wanted to use these archaeological data to commission costumes for the documentary's re-enactment scenes. Here, we look at the problems encountered and the basis on which choices were made.*

**Keywords** Gravettian, burials, adornment, re-enactment, documentaries

## Introduction

In Europe, a total of 81 individuals were found in graves that date into the Mid-Upper Palaeolithic (MUP) or Gravettian period, between -34 and 24 kya. These stem from 24 archaeological sites dispersed across 15 regions (Fig. 1). A total of 68 individuals were associated with adornment[1]. These burials form a very heterogeneous corpus in terms of preservation and potential use for reconstruction. 24 have excellent or good preservation, and eleven others have known, albeit imprecise, information, while for 33 on the other hand, the data is very poorly known or documented, and sometimes the information is virtually lost (Předmosti, Přerov District [Czech Republic] and La Rochette, Dép. Dordogne [France]) or not yet known (Cussac, Dép. Dordogne [France]; Coste in prep.).

Although not all are well-dated, the burials seem to cover the entire Gravettian period, with major regional differences. Some may date back to a slightly earlier period, such as in the case of the Sunghir burials, Vladimir Oblast, in Russia, or some of the Balzi Rossi, for example those from Baousso da Torre, both Liguria (BT1, BT2, BT3) in Italy (Fig. 2).

According to the amount of adornment, some of the burials are considered ›rich‹, and in a way, raise the question of

1 Pettitt 2011; Henry-Gambier 2008b; Henry-Gambier 2013; Orschiedt 2018; Giacobini 2006; Martini/Giacobini 2024; D'Errico/Vanhaeren 2015; Mussi 1986; Mussi 2004; Coste 2016; Coste in press.

**Fig. 1** Map of Gravettian burials. 24 archaeological sites across Europe in 15 areas mentioned in the article: 1 Paviland (UK); 2 Vilhonneur (France, Charente); 3 Cro-Magnon, Cussac, Pataud, La Rochette (France, Dordogne); 4 Le Figuier, Le Marronnier (France, Ardèche); 5 Lagar Velho (Portugal); 6 Cavillon Cave or Barma del Caviglione, Grotte des Enfants or Grotta dei Fanciulli, Barma Grande, Baousso da Torre (Italy, Liguria, Balzi-Rossi); 7 Arene Candide (Italy); 8 Paglicci Cave (Italy); 9 Ostuni (Italy); 10 Veneri Parabita (Italy); 11 Krems-Wachtberg (Austria); 12 Brno, Dolní Věstonice, Pavlov, Předmosti (Czech Republic); 13 Kostenki (Russia); 14 Sunghir (Russia); 15 Mal'ta (Russia).

***Abb. 1*** *Karte der im Artikel erwähnten gravettienzeitlichen Bestattungen. 24 archäologische Fundstätten in Europa in 15 Regionen: 1 Paviland (Großbritannien); 2 Vilhonneur (Frankreich, Charente); 3 Cro-Magnon, Cussac, Pataud, La Rochette (Frankreich, Dordogne); 4 Le Figuier, Le Marronnier (Frankreich, Ardèche); 5 Lagar Velho (Portugal); 6 Cavillon-Höhle oder Barma del Caviglione, Grotte des Enfants oder Grotta dei Fanciulli, Barma Grande, Baousso da Torre (Italien, Ligurien, Balzi-Rossi); 7 Arene Candide (Italien); 8 Paglicci-Höhle (Italien); 9 Ostuni (Italien); 10 Veneri Parabita (Italien); 11 Krems-Wachtberg (Österreich); 12 Brno, Dolní Věstonice, Pavlov, Předmosti (Tschechische Republik); 13 Kostenki (Russland); 14 Sunghir (Russland); 15 Mal'ta (Russland).*

the social hierarchies within these societies. This potential wealth can be questioned either by the quantity of ornaments or associated furnishings, as at Sunghir for example (Testart 2012), or by the rarity of materials deposited near the deceased, such as ivory in Italian burials or the quality of the exogenous flints at Barma del Caviglione, Liguria, Italy (De Lumley 2016; Onoratini et al. 2011).

The infrequency of individuals buried in this type of grave also raises the question of access to this type of burial. It should also be kept in mind that the clothing of the dead is not necessarily that of the living and that the finery found in a grave may be more of a funerary deposit than representative of the everyday clothing of the individual.

A number of individuals in our corpus (11) were found without associated finery. Of these, those from south-western France were the subject of a funeral ritual specific to this geographical area (Villotte et al. 2019), to the extent that for our purposes of reconstructing clothing, they offer little information. Moreover, the absence of adornment may mean that it was made of organic material (such as feathers, wood, or fur) and so was not preserved; alternatively, funeral rituals in this area may have excluded any form of clothing or personal ornaments. We can also imagine graves linked to sacrifices (Formicola 2007), as suggested by the injury of Sunghir 1 mentioned by E. Trinkaus/A. P. Buzhilova (2018), or other burials containing individuals whose bodies had been clearly restrained, probably by ropes, like DV3 (Czech Republic), Kostenki 14, Voronezh Oblast (Russia) Pettitt 2011). Such situations also distort our perception of their potential clothing.

Here, we present the main archaeological information, the precise geographical location of the burials, the finds of adornments associated with the individual bodies (Coste 2016; Coste in prep.), as well as photographs of some of the casts preserved at the University of Turin (Fig. 3–6; Giacobini 2006; Fabbri/Giacobini 2021). Furthermore, we compile the ornaments or types of adornment known from these MUP burial contexts (Fig. 7–8).

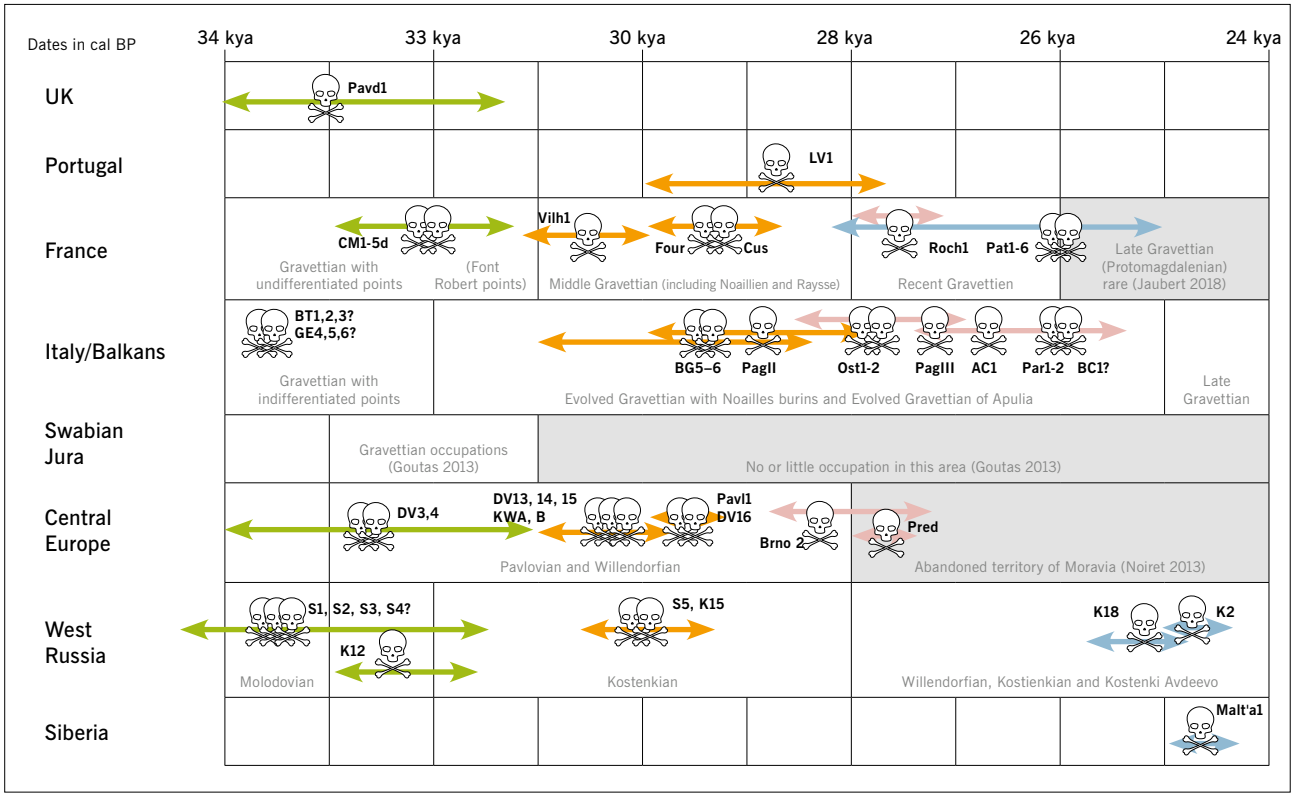



**Fig. 2** Timeline of Gravettian Burials (abbreviated): AC = Arene Candide; BC = Barma del Caviglione (Cavillon); BG = Barma Grande, Brno; BT = Baousso da Torre; CM = Cro-Magnon; Cus = Cussac; DV = Dolní Věstonice; Four = Fournol; GE = Grotte des Enfants; K = Kostenki, Malt'a; Ost = Ostuni; Pag = Paglicci; Par = Parabita; Pat = Pataud; Pavd = Paviland; Pavl = Pavlov; Pred = Předmosti; Roch = La Rochette; S = Sunghir.

***Abb. 2*** *Zeitleiste der gravettienzeitlichen Bestattungen (abgekürzt): AC= Arene Candide; BC = Barma del Caviglione (Cavillon); BG = Barma Grande, Brno; BT = Baousso da Torre; CM = Cro-Magnon; Cus = Cussac; DV = Dolní Věstonice; Four = Fournol; GE = Grotte des Enfants; K = Kostenki, Malt'a; Ost = Ostuni; Pag = Paglicci; Par = Parabita; Pat = Pataud; Pavd = Paviland; Pavl = Pavlov; Pred = Předmosti; Roch = La Rochette; S = Sunghir.*

## Italy

The Gravettian burials from Italy are the most numerous and the best preserved in terms of finery. They show many similarities among each other, even when comparing northern and southern Italy, reflecting traditions shared over long distances (Cavillon, Liguria/Ostuni, Apulia; Barma Grande, Liguria/Arene Candide 1, Liguria)[2]. The burials of men, women, and children/adolescents are equally adorned or unadorned. When the individual's sex is known, no particular difference can be noted between the sexes. However, the graves of women appear to be the most numerous. Young children and babies, however, are not present in the MUP record of burials in Italy (Henry-Gambier 2008a).

The preferred type of shellfish used for personal ornaments are *Tritia neritea* (previously *Cyclope neritea*), mainly found as head ornaments and representing the most numerous type, by far (Cavillon, Ostuni 1a–b, BG2-5, GE4 and GE6, BT2, AC1), with sometimes more than 100 in a single grave (Cavillon = 300, AC1 = 100; Quatrepoint et al. 2016; Palma di Cesnola 2002, 266). This Mediterranean shellfish, often found in great abundance in shallow lagoons, is not difficult to access for groups living close to the sea. The shell is easy to perforate when drilling with a little pressure.

They can also be worn as bracelets either on the arm or wrist (BT1, BT2, GE5, Ost1a, AC1) or on the leg (BC1, BT1; Tab. 1–2).

The next most frequent personal ornaments from Italian MUP burials are atrophic deer canines, also used mainly as head ornaments, often as a brow band (Pagl II, Pagl III, BC1, BT1, BT2, GE4, Par2, BG2–4). Deer canines as head ornaments are sometimes worn alone or in combination with *Tritia neritea* shells. They are also found in necklaces (BG2, BG4) or along the legs (BT1, Liguria, Paglicci II and III, Apulia).

Other types of shellfish are also present, sometimes representing a broad spectrum of species (e.g. BT2 see Coste 2016; Rivière 1887); fish vertebrae are present in the finery, as well (BG2–4). Mammoth ivory ornaments are rare in a region where this animal was not present (BG2–5, AC1).

In terms of exceptional preservation, the BG4 necklace is particularly noteworthy, its layout having been preserved and excavated from the clay (Fig. 7b). The composition is incredibly meticulous, showing a pattern that is repeated by a double row of four fish vertebrae, deer canines, and *Tritia neritea* shells. R. Verneau, who had worked a lot with the firsts archaeologists of the the Balzi Rossi Caves, wrote: ›A pretty necklace passed a little bit below the right angle of

2 Malerba/Giacobini 1992; Malerba/Giacobini 2014; Giacobini 2006; Martini/Giacobini 2024; Mussi 1986; Mussi 2004; Palma di Cesnola 2001; Formicola/Holt 2015; French/Nowell 2022.

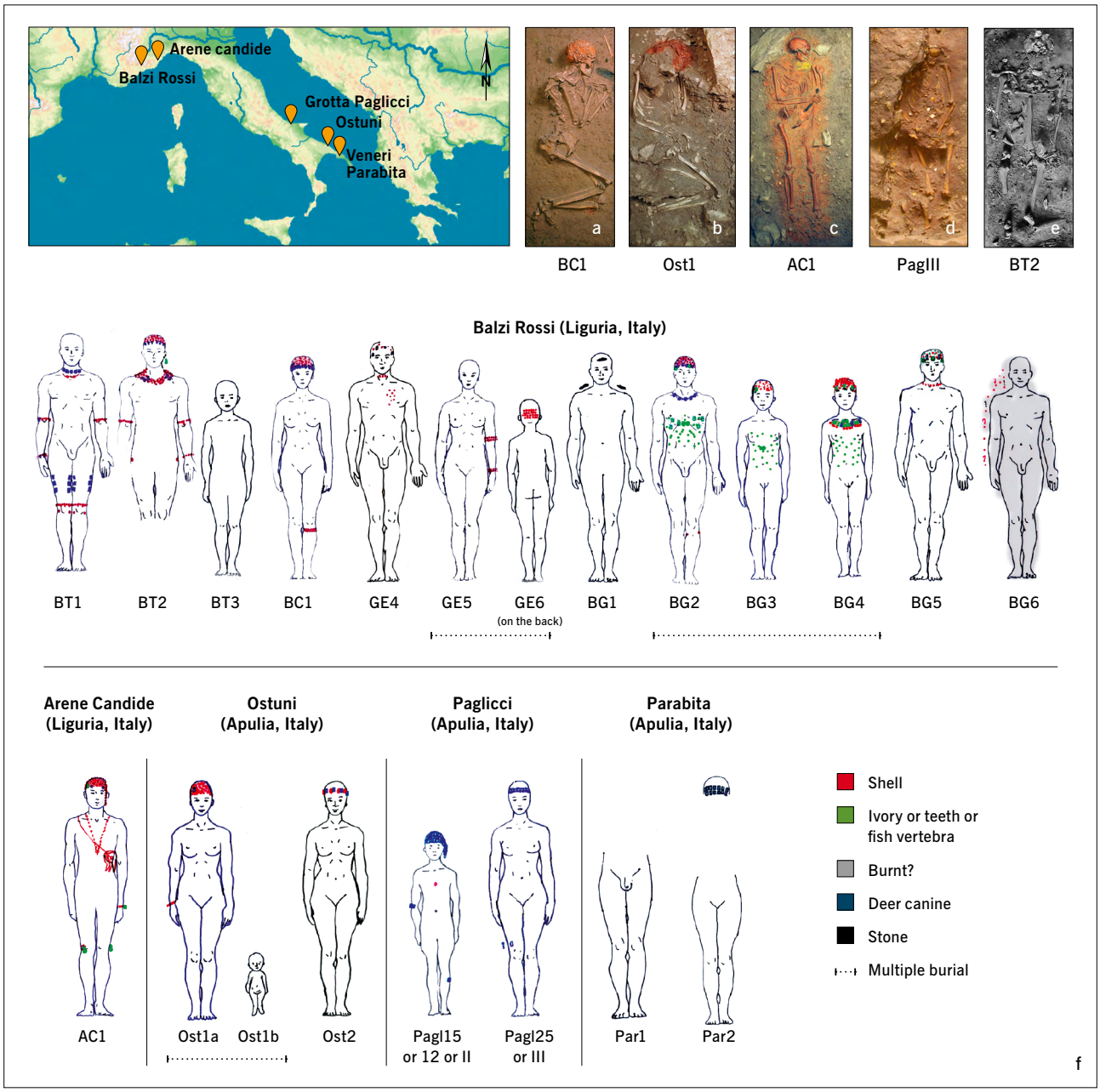
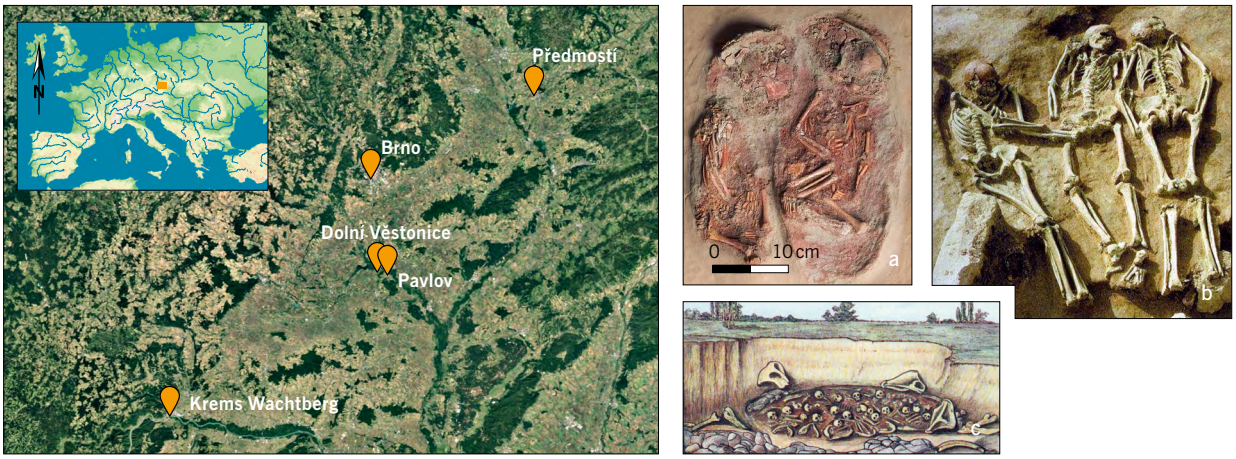



**Fig. 3a–f** Archaeological data for Italy. Gravettian individuals in burials and their adornments with a map of the locations of the Gravettian burials in Italy; a–e pictures of casts or originals of some Italian burials. a Cavillon (cast); b Ostuni 1a–b (cast); c Arene Candide 1 (cast); d Paglicci III (cast); e Baousso da Torre 2 (original, in the Musée d'Archéologie National in Saint-Germain-en-Laye, in the 1970's or 1980's); f drawings of P. Coste from archaeological records with location and found material (colour coded, see legend) of adornment on the bodies for Italian Gravettian burials.

***Abb. 3a–f*** *Archäologische Daten für Italien. Gravettienzeitliche Individuen in Gräbern und ihre Schmuckelemente mit einer Karte der gravettienzeitlichen Bestattungen in Italien; a–e Aufnahmen von Abgüssen oder Originalen einiger italienischer Gräber. a Cavillon (Abguss); b Ostuni 1a–b (Abguss); c Arene Candide 1 (Abguss); d Paglicci III (Abguss); e Baousso da Torre 2 (Original, im Musée d'Archéologie National in Saint-Germain-en-Laye, 1970er oder 1980er Jahre); f Zeichnungen von P. Coste gemäß der archäologischen Dokumentationen mit Lokalisierung, Art (farbig markiert, s. Legende) der gefundenen Schmuckelemente an und auf den Körpern in den gravettienzeitlichen italienischen Gräbern Italiens.*

**Fig. 4a–d (right page)** Archaeological data for Central Europe. Gravettian individuals in burials and their adornments with a map of the locations of the Gravettian burials in Central Europe (Czech Republic, Austria). a–c pictures or drawings of the discoveries *in situ*; a Krems-Wachtberg A–B; b triple burial of Dolní Věstonice DV13–15 during excavations; c only known drawing of the early discovery of Předmosti; d drawings of P. Coste from archaeological records. Place and material (colour code) of adornment on the bodies for Central Europe Gravettian burials. If it is not known where the decoration was located on the body, the beads are presented near the body but not on it.

***Abb. 4a–d (rechte Seite)*** *Archäologische Daten für Mitteleuropa. Gravettienzeitliche Individuen aus Bestattungskontexten und ihre Schmuckelemente mit einer Karte der gravettienzeitlichen Bestattungen in Mitteleuropa (Tschechische Republik, Österreich); a–c Aufnahmen und Zeichnung der entdeckten Gräber* in situ*; a Krems-Wachtberg A–B; b Dolní Věstonice DV13–15 während der Freilegung; c einzig bekannte Zeichnung der früheren Entdeckung von Předmosti; d Zeichnungen von P. Coste gemäß der archäologischen Dokumentationen mit Lokalisierung, Art (farbig markiert, s. Legende) der gefundenen Schmuckelemente an und auf den Körpern in den gravettienzeitlichen Gräbern Mitteleuropas. Wenn nicht bekannt war, wo sich die Verzierung auf dem Körper befand, wurden die Schmuckobjekte in der Nähe des Körpers, aber nicht auf ihm, dargestellt.*




**Dolní Věstonice (Moravia, Czech Rep.)**

DV3 DV4 DV13 DV15 DV14 DV16

**Předmosti (Moravia, Czech Rep.)**

Pr14 Pr9 Pr18 Pr3 Pr?

Pr7 Pr17 Pr4 Pr1 Pr5 Pr11 Pr12 Pr13

**Pavlov (Moravia, Czech Rep.)**

Pavlov 1

**Brno (Moravia, Czech Rep.)**

Brno 2

**Krems-Wachtberg (Lower Austria, Austria)**

KWA KWB KWC

Pr20 Pr2 Pr6 Pr8 Pr15 Pr22 ? Pr16 Pr25

d

Shell (fresh or fossil) or gastropods

Ivory (disc, pendant, rods) or tooth (carnivore canine, fox or wolf)

Marl disc

Multiple burial

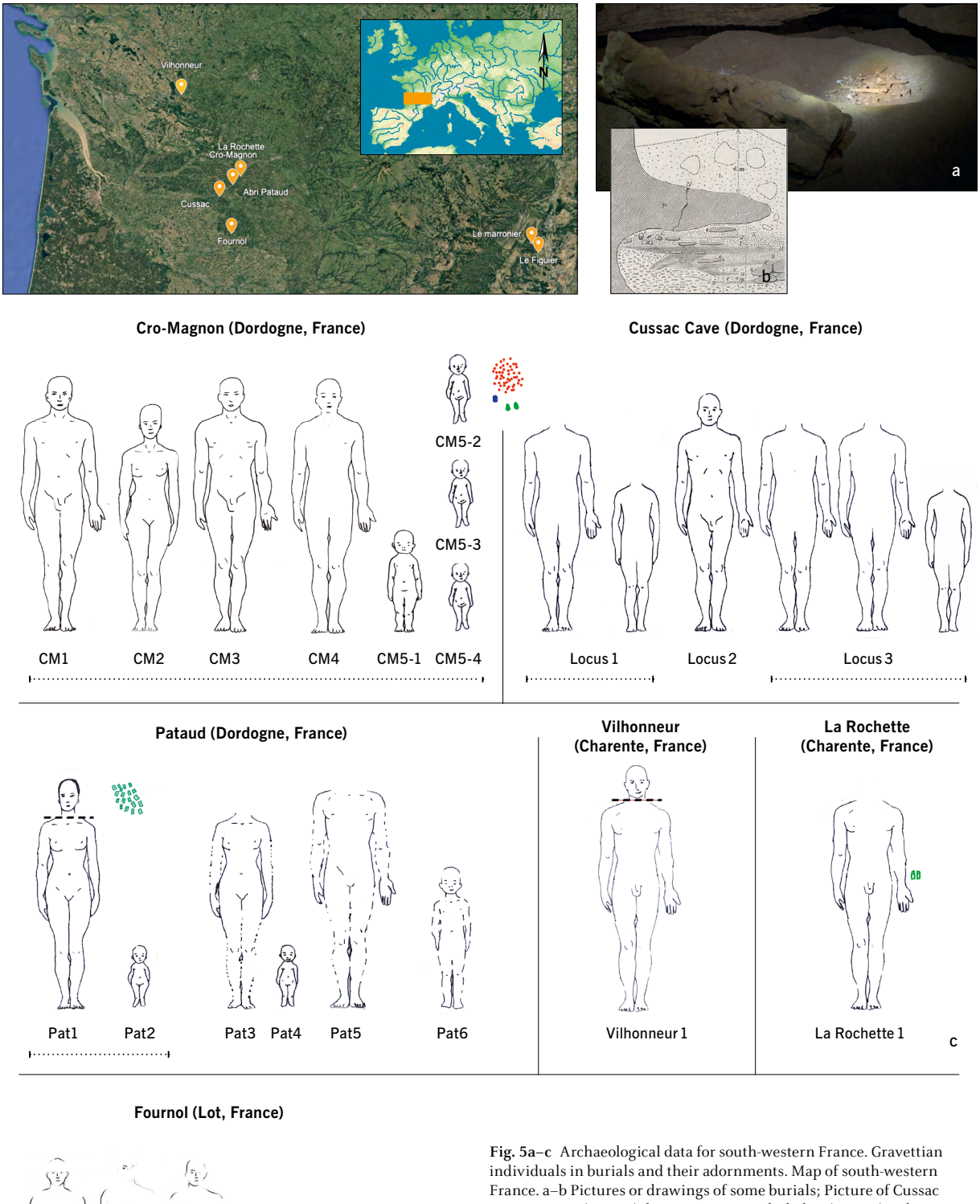



**Fig. 5a–c** Archaeological data for south-western France. Gravettian individuals in burials and their adornments. Map of south-western France. a–b Pictures or drawings of some burials; Picture of Cussac Cave, Locus 1 (France); b Cro-Magnon rock shelter (France); c drawings from archaeological records. Place and material (colour code) of adornment on the bodies for south-western France (when the information is lacking, the beads are presented close to the body but not on it).

***Abb. 5a–c*** *Archäologische Daten für den Südwesten Frankreichs. Gravettienzeitliche Individuen in Bestattungen und ihre Schmuckelemente. Karte von Südwestfrankreich. a–b Aufnahmen oder Zeichnungen der entdeckten Gräber; Bild der Cussac-Höhle, Locus 1 (Frankreich); b Cro-Magnon-Abri (Frankreich); c Zeichnungen gemäß der archäologischen Dokumentationen. Lokalisierung und Art (farbig markiert) der gefundenen Schmuckelemente an und auf den Körpern in Südwestfrankreich (wenn die Informationen fehlen, werden die Schmuckobjekte in der Nähe des Körpers, aber nicht auf ihm, dargestellt).*

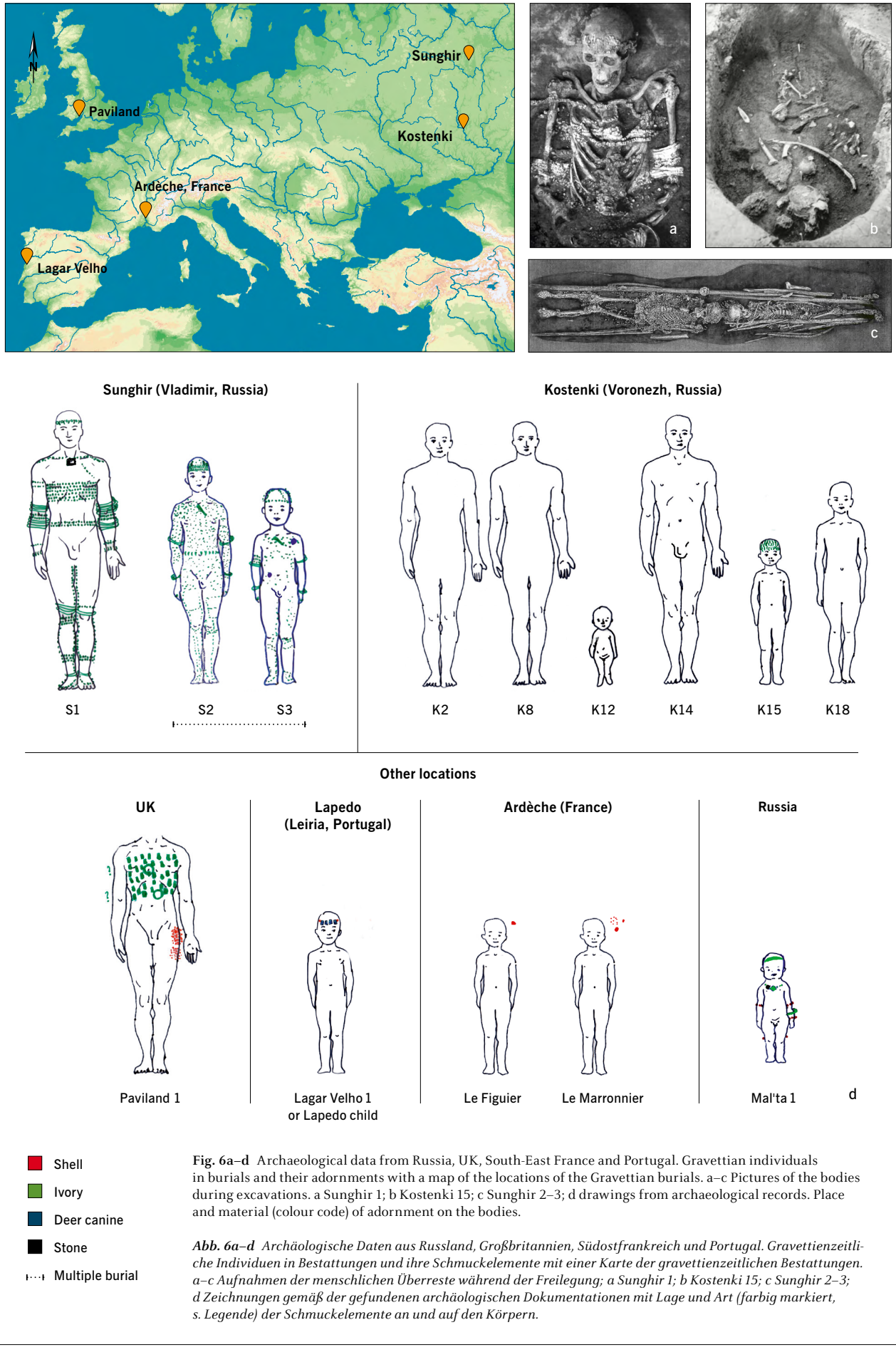



**Fig. 6a–d** Archaeological data from Russia, UK, South-East France and Portugal. Gravettian individuals in burials and their adornments with a map of the locations of the Gravettian burials. a–c Pictures of the bodies during excavations. a Sunghir 1; b Kostenki 15; c Sunghir 2–3; d drawings from archaeological records. Place and material (colour code) of adornment on the bodies.

***Abb. 6a–d*** *Archäologische Daten aus Russland, Großbritannien, Südostfrankreich und Portugal. Gravettienzeitliche Individuen in Bestattungen und ihre Schmuckelemente mit einer Karte der gravettienzeitlichen Bestattungen. a–c Aufnahmen der menschlichen Überreste während der Freilegung; a Sunghir 1; b Kostenki 15; c Sunghir 2–3; d Zeichnungen gemäß der gefundenen archäologischen Dokumentationen mit Lage und Art (farbig markiert, s. Legende) der Schmuckelemente an und auf den Körpern.*

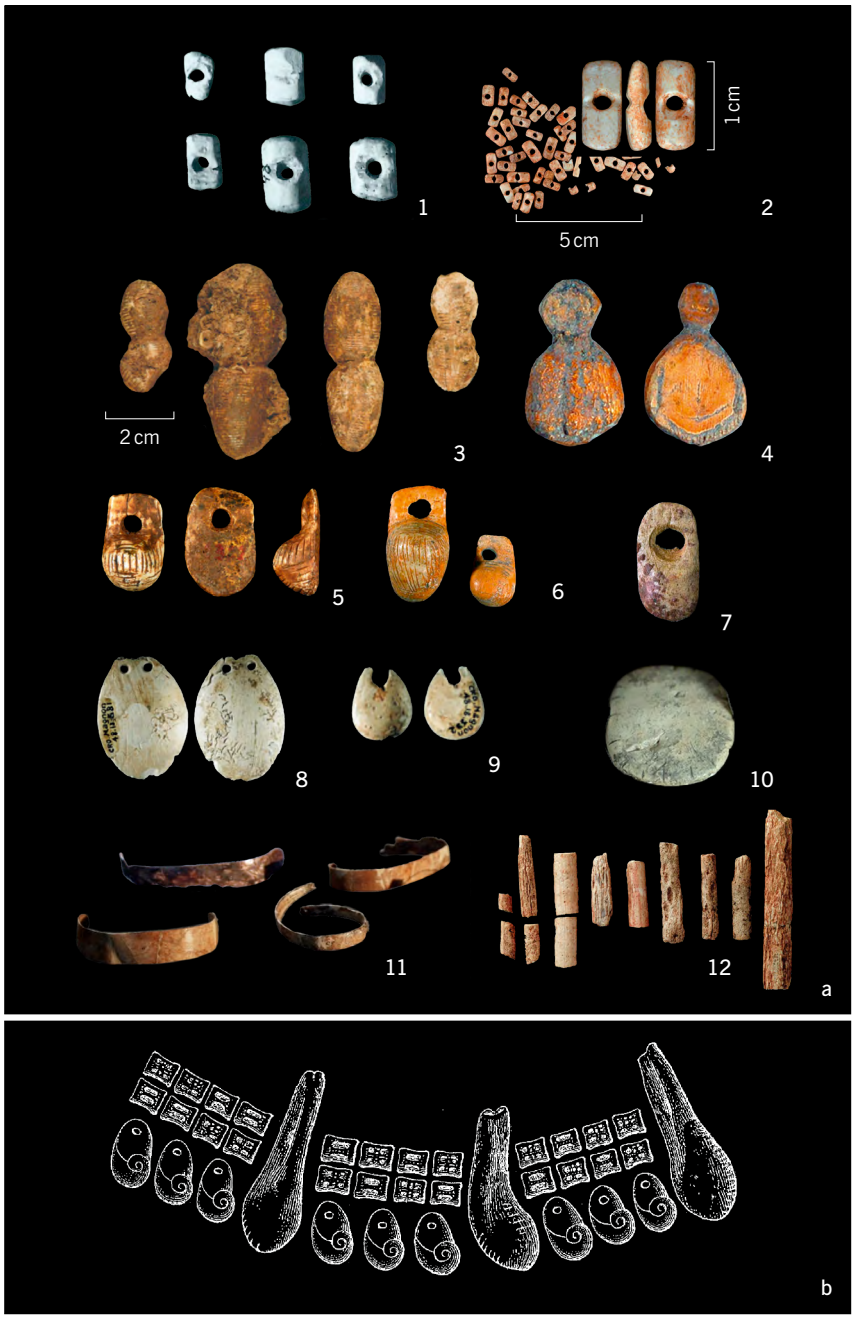



**Fig. 7a** Ivory adornments in Gravettian graves. Not to scale. 1–2 Rectangular beads: 1 Sunghir; 2 Pataud 1–2; 3–4 Bilobated beads: 3 Barma Grande triple burial; 4 Arene Candide 1; 5–6 asymmetric ivory pendant: 5 one from the Barma Grande triple burial; 6 Arene Candide 1; 7 symmetrical bead one of the 53 beads from Krems-Wachtberg A; 8–9 Cro-Magnon pendants; 10 ivory disk from Brno 2; 11 bracelets from Sunghir burials; 12 ivory rods from Paviland 1.

***Abb. 7a*** *Schmuckelemente aus Elfenbein in gravettienzeitlichen Gräbern. Nicht maßstabsgetreu. 1–2 Rechteckige Perlen: 1 Sunghir; 2 Pataud 1–2; 3–4 doppelt gelappte Perlen: 3 Dreifachbestattung aus Barma Grande; 4 Arene Candide 1; 5–6 Asymmetrischer Elfenbein-Anhänger: 5 einer aus der Dreifachbestattung von Barma Grande; 6 Arene Candide 1; 7 eine der 53 symmetrischen Perlen aus Krems-Wachtberg A; 8–9 Cro-Magnon; 10 Elfenbeinscheibe aus Brünn 2; 11 Armreife aus den Sunghir-Bestattungen; 12 Elfenbeinstäbchen aus Paviland 1.*

**Fig. 7b** Necklace from Barma Grande 4: *Tritia neritea*, red deer canine and fish vertebrae.

***Abb. 7b*** *Anhänger aus Barma Grande 4:* Tritia neritea, *Rotwild-Eckzähne und Fischwirbel.*

the lower jaw, but below that it had slipped, and the component parts lay under the left temple. The different pieces of this collar were held in the position that they had originally occupied by the earth into which they had been pressed. They comprised vertebrae of fish, *Tritia neritea* shells, and the canine teeth of deer, each specimen, of course, being pierced. The vertebrae were arranged in two parallel lines, and below them was a row of *Tritia neritea*[3]. At intervals,

**Fig. 8 (right page)** Shells, teeth, and stone ring types of adornments in Gravettian graves. Not to scale. 13–16 Globular shells: 13 *Tritia neritea*; 14 *Littorina obtusata*; 15 *Theodoxus*; 16 *Littorina littorea*; 17 *Luria lurida*; 18 *Zonaria pyrum*; 19 *Trivia europaea*; 20–23 Round and pointed shells; 20 *Melanopsis*; 21 *Buccinum corniculum*; 22 *Hinia reticulata*; 23 *Columbella rustica*; 24–27 Elongated shells: 24 *Dentalium* fossil; 25 *Cerithium vulgatum*; 26 *Tympanotonos cinctus fossil*; 27 *Turritella communis*; 28–30 Bivalves: 28 *Glycymeris violacescens*; 29 *Cardium*; 30 *Pecten* (8–10cm); 31–33 Teeth: 31 Deer canine; 32 Fox canine. Stone rings (diam. 15 cm): 33a one from Brno 2 grave; 33b one from Předmosti.

***Abb. 8 (rechte Seite)*** *Muscheln, Zähne und Steinringe als Ornamente gravettienzeitlichen Gräbern. Nicht maßstabsgetreu. 13–16 Kugelige Muscheln: 13* Tritia neritea*; 14* Littorina obtusata*; 15* Theodoxus*; 16* Littorina littorea*; 17* Luria lurida*; 18* Zonaria pyrum*; 19* Trivia europaea*; 20–23 Runde und spitze Muscheln; 20* Melanopsis*; 21* Buccinum corniculum*; 22* Hinia reticulata*; 23* Columbella rustica*; 24–27 Langgestreckte Muscheln: 24* Dentalium-Fossil*; 25* Cerithium vulgatum*; 26* Tympanotonos-cinctus-*Fossil; 27* Turritella communis*; 28–30 Muscheln: 28* Glycymeris violacescens*; 29* Cardium*; 30* Pecten *(8–10cm); 31–33 Zähne: 31 Eckzahn eines Hirsches; 32 Eckzahn vom Fuchs; Steinringe (D. 15 cm): 33a einer aus dem Grab von Brno 2; 33b einer aus Předmosti.*

3 R. Verneau (1900, 73) called excatly the seashell »*Nassa neritea*« now called *Tritia neritea*.

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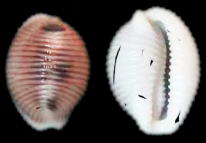

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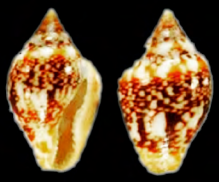

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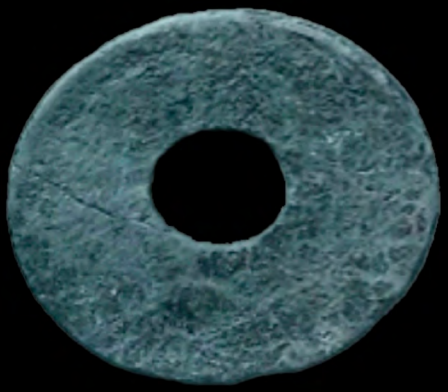

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33b

**Fig. 9** P. Coste (pregnant) trying on the Lady of Cavillon costume made by A. Gabillard during preparation of *Looking for Sapiens* in 2016.

***Abb. 9*** *P. Coste (schwanger) bei der Anprobe des Kostüms der Dame von Cavillon, das A. Gabillard während der Vorbereitung von* Looking for Sapiens *im Jahr 2016 angefertigt hat.*

these three rows were interrupted by a deer's tooth ornamented with striae‹ (cf. Fig. 7b; Verneau 1900, 73).

In the documentary *Ladies and Princes of Prehistory,* directed by the first author, the Lady of Cavillon (BC1: Barma del Caviglione 1) is the film's main character; therefore, her group and clothing were selected for reconstruction.

Only the headdress and a leg band of shells are known in her case, so the costume used for the TV documentary was largely hypothetical. Leathers and furs were chosen according to the fauna known from the Gravettian levels of the site (Rivière 1872, 1887): they included aurochs, deer, horse, and marmot. The choice of colour for the leathers worn by the Cavillon tribe was inspired by the fur of these animals (beige and brown).

In the sites monograph edited by H. de Lumley (2016) P. Valensi and A. Moussous (2016, 148–149) are even more precise: close to the burial, after the excavation at the Musée de l'Homme (1988/89), they found: deer, ibex, horse, wild boar, aurochs and roe deer. They mention that E. Rivière, the excavator of the site, also mentioned the presence of cave bear, a proboscidean, a rhinoceros, lynx, wolf, fox, and elk among the fauna.

Based on her study of the Lady of Cavillon's adornments on the skull, M. Quatrepoint, reconstructed headdresses in fishnets (Quatrepoint et al. 2016).

On the skull, the red colour is very strong where the headdress was supposed to be. But was it only a funerary practice or the colour of a dye garment? A choice was made in the documentary to dye the headdress in red ochre during the funeral of the main character (Lady of Cavillon), on screen, so as a post-mortem practice.

One of us (P. Coste) had already commissioned a costume for the Lady of Cavillon in 2018 for a previous documentary, *Looking for sapiens*. In this initial version, the headdress was ochred before (antemortem dye) and shells and a few deer canines were sewn on a headgear in leather. Cowhide leather was used for the costume, which was made by costume designer A. Gabillard[4] (Fig. 9), while those of the Lady of Cavillon's tribe for *Ladies and Princes of Prehistory* were created and sewn by costume designer M. Lagarde (Fig. 10–11).

The garments are hypothetical (warm tunic, fur trim on sleeves or hood, leather pants, moccasins). To evoke the Cavillon Lady's potential status as a clan leader, M. Lagarde wanted to use full sleeves to enhance the actress' charismatic appearance. However, these loose-fitting sleeves were problematic in that they made it difficult to wear a backpack (made of plant fibre by F. Moser) or to use a spear thrower.

The leg band, composed of some 40 *Tritia neritea* shells, was reconstructed as a garter, making the leather pants more comfortable to wear. But, of course, we could have alternatively imagined this band as a bracelet worn directly on the leather. The punch found near the Lady of Cavillon's skeleton could also have been part of the finery, as it was discovered close to her head (Rivière 1887, 139). This punch is made from a horse metatarsal and is 175.5 x 28.0 x 9.5 mm in size (Grégoire et al. 2016, 502–503). E. Rivière interpreted it as a weapon or a part of the headdress (Rivière 1887) but in the documentary, the director (P. Coste) chose to use it only as a funerary deposit.

4 The Looking for Sapiens' costume of Lady of Cavillon was created in 2016, with a very limited budget. This was during P. Coste's pregnancy (5th month), so she asked A. Gabillard to produce the costume to fit a pregnant woman. For this reason, the costume turned out to be rather large. Since in the Palaeolithic clothes were not often produced, women's clothing may have customarily been generously sized, as in Inuit groups.

**Fig. 10** Costume designs by M. Lagarde for the Lady of Cavillon (BC1) for *Ladies and Princes of Prehistory* (by P. Coste 2021).

***Abb. 10*** *Kostümentwürfe von M. Lagarde für die Dame von Cavillon (BC1) für* Ladies and Princes of Prehistory *(von P. Coste 2021).*

The clothes for the rest of the group were made similarly regarding the leather hues, to enhance the group's homogeneity. Another costume was made, and others were borrowed and altered to suit the additional actors (three men, four women, and three children). A bias may lie in the fact that the Balzi Rossi men in the documentary do not wear headdresses or adornment unlike the archaeological finds (Fig. 3)

M. Lagarde described the design process as follows: ›During the research for the Lady of Cavillon costume, we really questioned ourselves about the different possible traces of clothes, accessories and adornments, in terms of forms, materials, and techniques (sewing, braiding, embroidery, macramé, ornamental leather cuts, etc.). This was done so as not to fall into the stereotype of prehistoric costumes, and not to underestimate the cultural wealth of that era (see all the designs proposed for the Lady of Cavillon; cf. Fig. 10). The budgetary and time constraints do not often make it possible to restore the found adornments and realise

**Fig. 11a–d** Screenshots of Cavillon tribe in *Ladies and Princes of Prehistory* directed by P. Coste (Balzi-Rossi Cave, Gravettian). Costumes made by M. Lagarde or borrowed. a J. Chaussebourg, the actress who played the Lady of Cavillon with the headdress (fishnet) made by M. Quatrepoint; b scene of two women and a little girl (daughter of P. Coste) making headdresses (fishnets with shells; filmed on green screen); c scene of women and children collecting shells close to the Balzi-Rossi Cave (filmed on green screen in 2020); d scene of the Lady of Cavillon's burial (filmed on green screen, the incrustation of the background in the real wall of Cavillon's Cave in 2020).

***Abb. 11a–d*** *Bildschirmaufnahmen des Cavillon-Stammes in* Ladies and Princes of Prehistory *unter der Regie von P. Coste (Balzi-Rossi-Höhle, gravettienzeitlich). Die Kostüme wurden von M. Lagarde entworfen oder ausgeliehen. a J. Chaussebourg, die Schauspielerin, die die Lady of Cavillon spielte, mit dem von M. Quatrepoint angefertigten Kopfschmuck (Fischnetz); b Szene mit zwei Frauen und einem kleinen Mädchen (Tochter von P. Coste), die Kopfschmuck (Fischnetz mit Muscheln; auf Greenscreen gefilmt) herstellen; c Szene mit Frauen und Kindern, die in der Nähe der Grotte von Balzi-Rossi Muscheln sammeln (2020 auf Greenscreen gefilmt); d Szene der Beisetzung der Lady of Cavillon (auf Greenscreen; die Inkrustation des Hintergrunds in der echten Wand der Höhle von Cavillon im Jahr 2020).*

**Fig. 12** Costume designs by M. Lagarde for Dolní Věstonice for *Ladies and Princes of Prehistory* (by P. Coste 2021).

***Abb. 12*** *Kostümentwürfe von M. Lagarde für Dolní Věstonice für* Ladies and Princes of Prehistory *(von P. Coste 2021).*

hypotheses of clothing with original techniques; by default, the costumes are made in simplified forms. For *Ladies and Princes*, almost all the costumes were sewn by hand, which was already very time-consuming«.

The actor's skin colour was chosen according to aDNA evidence, even though it was hard to find publications about skin colour for the Gravettian period at the time of the shooting (2020). Therefore, we had to interview anthropologists, prehistorians or geneticists (S. Villotte, M.-F. Deguilloux, B. Valentin) to make choices for both actors and extras. These requirements complicated the casting of actors: finding dark-skinned individuals with flint knapping skills in Périgord (South-West France) was difficult. A compromise was made with actors of different colour skins but not necessarily coherent group. Although Ostuni 1a would have been darker-skinned than other brown-skinned Italian individuals of the period[5], to be honest, we did not know this at the time of the shooting.

Recent publications support our choice of brown skin colour (Jablonski 2021), whereas the eye colour may have been incorrect. It was light in the shooting, but – according to more recent studies – eye colour was perhaps more brownish in the Gravettian period.

The documentary also highlighted three other sites with exceptional burials for which clothing had to be reconstructed: Dolní Věstonice, Sunghir and Cussac.

## Central Europe

33 Gravettian burials are known from Central Europe, 20 of which came from the poorly documented multiple burial sites of Předmosti in the Czech Republic. These remains, which stem from early discoveries, have unfortunately been lost; only a few skull casts, such as Předmosti 3, survive[6].

Personal ornaments are quite rare in Central European MUP burial contexts. They often comprise carnivore canines (foxes or wolves) or sometimes ivory pendants (Krems-Wachtberg, Lower Austria [Austria], Dolní Věstonice [Břeclav District] triple burial, Předmosti, both Czech Republic). They are worn on an individual's head (DV14–15, Pred 22), neck (DV4), or near the hand (DV3). The only truly exceptionally ornamented burial from Central Europe is that from Brno 2, preserved in the Moravian Museum in Brno. Very different from the Dolní Věstonice, burials, Brno 2 includes a large number of *Dentalium* fossils (cf. Fig. 7,24), which were spread widely around the individual's head (Valoch 1996, 144). Other shells were found with the burial of the Krems-Wachtberg twins (KWA-B) at the neck of the second baby (cf. Fig. 7,15; Teschler-Nicola et al. 2020) but they were not *Dentalium* but *Theodoxus*.

Parallels can be observed in the burial sets from Brno 2 and Předmosti, notably in the similarly worked stone disc rings (cf. Fig. 7,33a–b; Valoch 1996, 144). Central European finery is much less varied compared to the evidence from Italy. This was taken into account in the manufacture of the costumes, which were designed to evoke a colder climate than Italy, and this was reflected in the choice of furs.

In *Ladies and Princes of Prehistory*, the Dolní Věstonice triple burial of three young adult men was taken as a reference (DV13–15; cf. Fig. 4). For these individuals, on the advice of one of us (P. Coste), the costume designer planned very warm, light-coloured garments resembling the fur of reindeer or polar fox (Fig. 12). Fox canines (casts) and oval pendants sewn on warm caps, coloured in ochre, were the only garments associated with the triple burial (Svoboda 2010, 57–58; Pettitt 2011). Fur coats were salvaged from a second-hand shop (for reasons of cost, ethics, and not wanting to encourage the exploitation of furs). Two costumes were created in this way. DV13's ochred skullcap should have inspired the design of the headgear, but although one of us (P. Coste) filmed in the site's anthropology laboratory in August 2020, the information reached the costumers too late to be utilised accordingly.

The scene's additional costumes (for the third deceased individual and the extras taking part in the funerary ritual) were borrowed. The warmest reindeer fur costume – (worn by the third deceased and in a few other scenes) was made by L. Bernat (director of the Le Bournat site, Dép. Dordogne [France]) for a TV show *›Les pouvoirs extraordinaires du corps humain‹* filmed in the Dordogne around 2015 for France TV. This costume (coat and pants) is currently preserved by the guides speakers of the Musée

5 <https://genetiker.wordpress.com/pigmentation/> (31.07.2025).

6 Henry-Gambier 2008b; Pettitt 2011; Valoch 1996; Neugebauer-Maresch 1999.

**Fig. 13a–d** Screenshots of Dolní Věstonice burial and costumes (inspired by DV13–15 triple burial) in *Ladies and Princes of Prehistory* directed by P. Coste. Costumes made by M. Lagarde or borrowed. a M. Lacoste wearing a reindeer costume made by L. Bernat; b–c Reconstruction of the Dolní Věstonice triple burial (DV13–15) during the funeral (filmed on green screen, 2020); c close up (of b): beads sewn on red coloured headgears are visible; d screenshot of Gravettian groups on a map in *Ladies and Princes of Prehistory*. Couples (men and women) were filmed on greenscreen in studio for each region to show the diversity of clothing and adornment in the Gravettian period.

***Abb. 13a–d*** *Bildschirmaufnahmen der Bestattung von Dolní Věstonice und der Kostüme (inspiriert von der Dreifachbestattung DV13–15) in* Ladies and Princes of Prehistory *unter der Regie von P. Coste. a M. Lacoste trägt ein Rentierkostüm von L. Bernat; b–c Rekonstruktion der Dreifachbestattung von Dolní Věstonice (DV13–15) während der Beisetzung (gefilmt auf Greenscreen, 2020); c Nahaufnahme (von b): die auf rot gefärbte Kopfbedeckungen genähten Perlen sind sichtbar; d Bildschirmaufnahme der gravettienzeitlichen Gruppen auf einer Karte in* Ladies and Princes of Prehistory. *Für jede Region wurden Paare (Männer und Frauen) auf Greenscreen im Studio gefilmt, um die Vielfalt der Kleidung und des Schmucks im Gravettien zu zeigen.*

National de Préhistoire in Les Eyzies (Fig. 13a–c). Another costume, which had originally been made for the Lady of Cavillon in *Looking for Sapiens*, was here worn by a man (cf. Fig. 13b, right). Finally, the last costume – worn by a woman – is the personal property of S. Géraud (an extra in *Ladies and Princes of Prehistory* who usually works in the Lascaux Cave). She tanned and sewed it herself, and wore the tunic, pants, lined boots, hat, and gloves during actual cold conditions during a stay in the Nordic countries (Fig. 13b.d).

## Russia

The Sunghir burials are the best-known in the Palaeolithic and the most richly decorated, comprising the burial of an adult man (S1) and the double burial of the S2–S3 children. Ornamentation of the burials is extremely rich and is composed of numerous tiny ivory beads (over 10 000 in total on the three individuals), mostly aligned in rows or bands, fox canines (up to 250 worn as belts for the adolescent S2), bracelets (some dyed black[7]) and the children's imposing funerary furnishings (ivory spears, figurines, etc.; cf. Fig. 5; Dobrovolskaya 2012; White 1993).

Leaving aside the sheer richness of the Sunghir burials, in some respects, especially in the choice of materials – ivory and carnivore teeth – the ornaments known from Russia are very similar to those from Central Europe. They were mainly worn on the head. The S2 and S3 from Sunghir, aged 7–10 years, Kostenki 18, Předmosti 22, and DV4 are the few exceptions buried with larger amounts of personal ornaments. In contrast, adults from this region and this period mostly lack ornaments.

Production of the Sunghir costumes was very labour-intensive. The fur components of the garments were chosen in black (with no specific reference to local fauna) to enhance the contrast with the light-coloured ivory beads; the furs were salvaged from second-hand shops, as was the case for Dolní Věstonice. The most complicated part of the clothing reconstruction was making, finding, and attaching 10 000 beads. M. Lacoste and L. Franceschi made 2000 beads in soapstone (the most visible ones on the headgear), which

7 R. White (1993) states: re Sunghir 1: ›His forearms and biceps were each decorated with a series of polished mammoth ivory bracelets (25 in all), some showing traces of black paint‹.

**Fig. 14** Costume designs by M. Lagarde for Sunghir for *Ladies and Princes of Prehistory* (by P. Coste 2021).

***Abb. 14*** *Kostümentwürfe von M. Lagarde für Sunghir für* Ladies and Princes of Prehistory *(von P. Coste 2021).*

alone required about 60–90 hours of work. Similar but plastic beads were purchased over the Internet to complete the picture. The whole ensemble was sewn by M. Lagarde and her assistant; strung onto threads, the beads were then sewn onto the garments (tunics, pants, boots, and headgear). Small capes made of dark fur were added, held in place by bone pins (Fig. 14–15).

A few ivory finger rings were added[8], as well as a stone pendant with a red dot for the man, and ›ivory‹ bracelets made of plastiline. Two white-painted wooden spears made by the prop designer were added as funerary goods (representing the Sunghir ivory spears). Despite the team's efforts and two months' preparation of the entire set of costumes, the result was still less rich than the actual burial context. The filter added to the movie to provide a less realistic impression and enhance the ambiguity of the reconstructions and scenes created a kind of ›painting‹ effect that tended to erase some of the fine details of the reconstructions.

## South-West France

Gravettian Burials of south-western France have yielded highly fragmentary remains of numerous individuals at several sites, mainly in the Dordogne area (Cro-Magnon, Pataud, Cussac) or close to it: Vilhonneur (Dép. Charente), Fournol (Dép. Lot). However, very few of these are of interest for reconstruction purposes (cf. Fig. 5).

To begin with, some are probably secondary burials (Cussac Locus 1 and 3, Fournol; Villotte et al. 2019; Villotte et al. 2021) or have not yet been fully excavated (Cussac Locus 2; Jaubert et al. 2020). Other individuals have no – or very rare – ornaments (Foucher et al. 2019).

Only those from Cro-Magnon (5 or 8 individuals, Partiot et al. 2020), Pataud (Nespoulet 2013; Vercoutère et al. 2011) and La Rochette 1 (Bosinski 1990, 65; Orschiedt 2002; Delporte 1962) have yielded finery, but they are so diverse in nature and spread over the entire Gravettian period that it is difficult to establish consistent patterns for MUP dress in south-western France (cf. Fig. 2).

At Cro-Magnon, numerous shells, mostly *Littorina* sp., or *Turritella* sp. (now dispersed throughout the world), were found[9] (Fig. 8,16.27). Teardrop-shaped ivory pendants, which resemble objects from the early Gravettian layers of Abri Pataud (layer 5), are also known (Henry-Gambier et al. 2013). However, the early date of the excavations at Cro-Magnon and the lack of precise records do not allow us to associate these finds with any particular individual.

At Abri Pataud, small ivory beads were found associated with the burials Pataud 1 and 2 (n = 94; cf. Fig. 7,2; Nespoulet et al. 2013); they are very similar to those at Sunghir (cf. Fig. 7,1) and – on a more local level – to those at Blot and Peyrugues, although discovered in much smaller numbers. The remains are extremely fragmentary, and it is difficult to locate the adornment on the body. At the same time, despite good excavations in the 1950s by H. L. Movius Jr., the contextual information available is patchy. The level of the burials (layer 2), dated to the Late Gravettian period, has yielded other elements of adornment, including fossil shells.

8 Only one is mentioned for Sunghir 10 in Trinkaus/Buzhilova 2018, 10; but we first found this information in Leroi-Gourhan 1988, 1049 for Sunghir 2 and 3).

9 Bougard 2014; Baker et al. 2022; Taborin 1993; Taborin 2000; Taborin 2004.

**Fig. 15a–d** Screenshots of the Sunghir burial and costumes in *Ladies and Princes of Prehistory* directed by P. Coste. Costumes made by M. Lagarde and her assistant or borrowed. 2000 beads made by M. Lacoste and L. Franceschi, 5000 plastic beads added. a Children of Sunghir 2–3. Costumes based on the archaeological finds in the double burial; b scene of the burial of Sunghir 1 (filmed on greenscreen studio in 2020); c evocation scene of meeting and trade between two Gravettian groups. On the right: based on Sunghir tribe, on the left the Cavillon or Balzi-Rossi tribe. They exchange Mediterranean *Tritia neritea* shells and long flint blades. In the reality, the two groups probably never met. d Sunghir 1 (in the middle) and the Sunghir 2 and 3 children. All costumes are based on the archaeological finds in the burials.

***Abb. 15a–d*** *Bildschirmfotos der Bestattungen von Sunghir und der Kostüme aus* Ladies and Princes of Prehistory *unter der Regie von P. Coste. Die Kostüme wurden von M. Lagarde und ihrer Assistentin angefertigt oder ausgeliehen. 2000 Perlen wurden von M. Lacoste und L. Franceschi angefertigt, 5000 Plastikperlen hinzugefügt. a Kinder aus Sunghir 2–3. Die Kostüme basieren auf den archäologischen Funden in der Doppelbestattung; b Szene der Bestattung von Sunghir 1 (gefilmt auf Greenscreen, 2020); c Szene der Begegnung und des Handels zwischen zwei gravettienzeitlichen Gruppen. Auf der rechten Seite: der Stamm aus Sunghir, auf der linken Seite der Stamm aus Cavillon oder Balzi-Rossi. Sie tauschen mediterrane* Tritia neritea*-Muscheln und lange Feuersteinklingen aus. In der Realität sind sich die beiden Gruppen wahrscheinlich nie begegnet. d Sunghir 1 (in der Mitte) und die Sunghir 2–3-Kinder. Alle Kostüme basieren auf den archäologischen Funden aus den Gräbern.*

**Fig. 16a–b** Screenshots evoking Pataud 1 (beads)/Cussac Cave in *Ladies and Princes of Prehistory*. a Close up of Fig. 13d. Evocation of the southern-west France group (M. Lacoste and L. Franceschi, who made the Sunghir and Pataud beads, as extras); b L. Franceschi wearing a costume with Pataud beads on the headdress.

***Abb. 16a–b*** *Bildschirmaufnahmen, die an Pataud 1 (Perlen)/Cussac-Höhle in* Ladies and Princes of Prehistory *erinnern. a Nahaufnahme von Abb. 13d. Lebensbild der südwestfranzösischen Gruppe (M. Lacoste und L. Franceschi, die die Sunghir- und Pataud-Perlen hergestellt haben, als Statisten); b L. Franceschi trägt ein Kostüm mit Pataud-Perlen auf dem Kopfschmuck.*

The individual from La Rochette from Hauser's old excavations would have yielded a few horse incisors along the legs or in the hand (Orschiedt 2002).

Scenes were planned to evoke the Cussac burials. The production could not afford to make new costumes for the South-West France scene, so the actors dressed in a mixture of existing or borrowed costumes (Fig. 16). The shells and deer canines of the ochre headgear (made in 2018 for Looking for Sapiens, Fig. 9) were cut off, and rectangular ivory beads (made by L. Franceschi and M. Lacoste) were added to evoke Pataud's finery. The choice of head adornment is arbitrary but consistent with what is known elsewhere for the Gravettian period.

The director (P. C.) would have preferred red costumes to evoke the traces of red colour found in on the walls in Cussac Cave (Jaubert et al. 2020, 181) but because of economical problems only re-use of other costumes was possible.

These traces may hint at the clothing worn when the dead were carried into the cave for funeral rituals or may have been left by those who produced the engravings in the cave.

The South-West France individuals are also visible on the general map (e.g. see Fig. 13d) where a man and a woman (one couple per site) were filmed in the green screen studio.

## Other Gravettian burials

Other countries or geographical areas have yielded Gravettian burials not mentioned in the Arte movie: the Red Lady of Paviland, West Glamorgan, Wales; the Lapedo child of Lagar Velho, Leiria District, Portugal (whose ornaments are very reminiscent of those in Italy); two very poorly preserved child burials in the Ardèche region, south-east France (Figuier 1, St. Martin d'Ardèche, and Marronnier 1, St.-Remèze; Slimak/Plisson 2008; Onoratini/Combier 1995); and a more recent discovery in Mollet Cave, Catalonia (Spain)[10] (cf. Fig. 6; Soler et al. 2013).

Further east in the Russian Baikal region, the burial of the Mal'ta 1 child, Oblast Irkutsk, is also dated to a final phase of the MUP.

10 Not in our study. We found this information too late to add it.

| P. Coste 2025 | | Ivory | | | | | | | | | Bones | | | | | | Teeth | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | deer or reindeer | | | carnivores | | | | | | | |
| Abr | Name of remains | »rods« | rings/bracelets | Ovale pendant | rectangular pendant | assymetric pendant | bilobated bead | Ivory washer | rounded and flat beads | other pendant | punch or drumstick | bone washer | fish vertebra | artic fox bones tail | diadem | head of femoral pierced | reindeer canine | deer spit | deer spit marked | bovid incisor | horse tooth | mammoth molar washer | bear canine | artic fox canine | fox's incisor | wolf canine | canine of carnivore not specified |
| Pavd | Paviland 1 | 40–50 | 2 fgt. | | | | | | | | 1? | | | | | | 2 | | | | | | | | | | |
| CM | Cro-Magnon 1-5-4 (8) | | | 2 | | | | | | | | | | | | | | 1 | | 1 | | | | | | | |
| Pat | Pataud 1–2 | | | | 94 | | | | | | | | | | | 1** | | 1** | | | | | | | | | |
| Roch | La Rochette 1* | | | | | | | | | | | | | | | | | | | | x | | | | | | |
| Fig | Le Figuier 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Marr | Le Marronnier 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LV | Lagar Velho 1 | | | | | | | | | | | | | | | | | 4 | | | | | | | | | |
| BC1 | Cavillon 1 | | | | | | | | | | 1 | | | | | | | 63 | | | | | | | | | |
| BT1 | Baousso da Torre 1 | | | | | | | | | | | | | | | | | 4 or + | | | | | | | | | |
| BT2 | Baousso da Torre 2 | | | | | | | | | | | | | | | | | 7 | | | | 1 | | | | | |
| GE4 | Grotte des Enfants 4 | | | | | | | | | | | | | | | | | x | | | | | | | | | |
| GE5 | Grotte des Enfants 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |

## Conclusion

Producing re-enactment costumes involves financial and archaeological compromises, as well as visual choices. The detailed shapes of the Palaeolithic garments will always remain unknown to us. However, to counter the clichéd caveman garb of caricatures, it seems important to make ›honest‹ reconstructions, to use S. Quertelet's term (2010).

The place and choice of adornments on the garment and the choice of post- or ante-mortem use of the red colour on the body or clothes have led to richer, warmer and more elaborate clothing designs than are usually seen in reconstructions of Palaeolithic lifeways.

In *Ladies and Princes of Prehistory*, the wealth and diversity of Gravettian burials was a marvellous source of information for gauging the potential variety of Upper Palaeolithic clothing – available for the relatively short period of roughly 10 000 years known as the Gravettian – dress conventions that had spread over a vast geographical area in Eurasia. We can thus imagine regional fashions suggesting local traditions and tribes (cf. Fig. 13d). Given the vast regional spread and the temporal depth included in the MUP, the diverse spectrum of clothing evidence offers a far more coherent image of past hunter-gatherer societies than that of a continuous homogeneity and uniformity.

Even though we must emphasise that the garments used for the *Ladies and Princes of Prehistory* documentary remain to some degree hypothetical, we also underscore that these reconstructions are consistent with the archaeological evidence, both regarding the period and the regional differences addressed in the documentary. This approach deserves to be more widely used in documentaries, museography, and films and – it is to be hoped – with more resources and, wherever possible, precise references in the reconstructions.

## Acknowledgements

Many thanks to the editors and reviewers of this article. Many thanks to Jan Vasak and Camille Monin of Enfant Sauvage Productions who produced *Ladies and Princes of Prehistory*, and to the Arte TV Channel and Czech TV. Many thanks also to the organisers of the conference who proposed screening the documentary, to Francesco D'Errico for his support, to Jacques Jaubert who agreed to be a consultant on the documentary, and to costume designer Marine Lagarde, for her permission to use her drawings and for re-reading this article.

| Shells and gastropods | | | | | | | | | | | | | | | | | | | | | | | | Stone | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| globular | | | | | | bivalves | | | longs | | »round and sharp« | | | | | | | | | | | vulva | | | | | |
| *Littorina obtusata* | *Littorina littorea* | *Theodoxus* sp. | *Tritia neritea* | small gastropod | gastropod *Arianta arbustorum alpicola* | *Cardium edule* | *Glycimeris violascens* or sp. | *Pecten* | *Tympanos-cintus fossil* | *Dentalium* (*F* = *fossil*) | *Cerithium* | *Turitella communis* | *Nassa incrassata* | *Nassa reticulata* | *Buccinum corniculum* | *Columbella rustica* | *Melanopsis* | *Fusus (colus)* | *Nassarium circumcintus* | *Phallium* sp. | *Purpura (nucella) lapillus* | *Cypraea* sp., or *Zonaria pyrum* or *Luria lurida* | *Trivia europea* | marl perced disc | stone washer | schist pendant | sea urchin pierced |
| xx | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 300 | | | | | | | | | | | 2 or + | | | | | | 1 | | | x | | | | | | |
| | | | | | | | | | 3** | | | | | | | | | | | | | | | | | | x** |
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| | | | 300 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 103 | | | | | | | | | | | | 10 | | | | | | | 8 | | | | | |
| | | | 133 or + | | | 1 | | | | | 2 | | x | x | 20 | | | | | | | 6 | 52 | | | | |
| | | | x | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | x | | | | | | | | | | | | | | | | | | | | | | | | |

*Continued on the next page*

| | P. Coste 2025 | Ivory | | | | | | | | | Bones | | | | | | Teeth | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | deer or reindeer | | | carnivores | | | | | | | |
| Abr | Name of remains | »rods« | rings/bracelets | Ovale pendant | rectangular pendant | assymetric pendant | bilobated bead | Ivory washer | rounded and flat beads | other pendant | punch or drumstick | bone washer | fish vertebra | artic fox bones tail | diadem | head of femoral pierced | reindeer canine | deer spit | deer spit marked | bovid incisor | horse tooth | mammoth molar washer | bear canine | artic fox canine | fox's incisor | wolf canine | canine of carnivore not specified |
| GE6 | Grotte des Enfants 6 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BG2 | Barma Grande 2 | | | | | 3 | 1 | | | | | | xx | | | | | | 16 | | | | | | | | |
| BG3 | Barma Grande 3 | | | | | 1 | 1 | | | | | | x | | | | | | | | | | | | | | |
| BG4 | Barma Grande 4 | | | | | x | 1 | | | | | | x | | | | | | x | | | | | | | | |
| BG5 | Barma Grande 5 | | | | | 3 | | | | | | | x | | | | | 2 | | | | | | | | | |
| BG6 | Barma Grande 6 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AC1 | Arene Candide 1 | | | | | 2 | 2 | | | | | | | | | | | 2 | | | | | | | | | |
| Ost1 | Ostuni 1* | | | | | | | | | | | | | | | | | 1 | | | | | | | | | |
| Ost2 | Ostuni 2* | | | | | | | | | | | | | | | | | x | | | | | | | | | |
| Pag15 | Paglicci 15 or II* | | | | | | | | | | | | | | | | | 40 | | | | | | | | | |
| Pag25 | Paglicci 25 or III | | | | | | | | | | | | | | | | | 8 | | | | | | | | | |
| Par2 | Parabita 2 | | | | | | | | | | | | | | | | | 29 | | | | | | | | | |
| KWA | Krems-Wachtberg A* | | | 53 | | | | | | | | | | | | | | | | | | | | | | | |
| KWB | Krems-Wachtberg B* | | | | | | | | | | | | | | | | | | | | | | | 1 | | | |
| KWC | Krems-Wachtberg C* | | | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| Brno 2 | Brno 2 | | | | | | | 5 | | | | 3 | | | | | | | | | 11 | 3 | | | | | |
| DV3 | Dolní Věstonice 3 | | | | | | | | | | | | | | | | | | | | | | 10 | | | | |
| DV4 | Dolní Věstonice 4 | | | | | | | | | | | | | | | | | | | | | | 42 | | | | |
| DV13 | Dolní Věstonice 13* | | | 5–10 | | | | | | | | | | | | | | | | | | | 13 | | x | | |
| DV14 | Dolní Věstonice 14* | | | | | | | | | | | | | | | | | | | | | | 4 | | 3 | | |
| DV16 | Dolní Věstonice 16* | | | | | | | | | | | | | | | | | | | | | | 3–4 | | | | |
| Pred | Předmosti 1–20 | x | | | | | x | | | | | | | | | | | | | | | | | | | | x |
| Pred22 | Předmosti 22 | | | | | | | | | | | | | | | | | | | | | | x | | | | |
| Pred | Předmosti other child | | | 14 | | | | | | | | | | | | | | | | | | | | | | | |
| K15 | Kostenki 15 | | | | | | | | | | | | | | | | | | | | | | 150 | | | | |
| S1 | Sunghir 1* | | 25 | | 2936 | | | | | | | | | | | | | | | | | | x | | | | |
| S2 | Sunghir 2* | | 8 | | 4903 | | | x | | | 1 | | | 1 | | | | | | | | | 250 | | | | |
| S3 | Sunghir 3* | | 13 | | 5274 | | | x | | | 1 | | | | | | | | | | | | | | | | |
| S5 | Sunghir 5 | | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | |
| Malt'a | Mal'ta 1* | | 1 | | | 6 | | | xx | 3 | 1 ? | | | | 1 | | | | | | | | | | | | |

* DNA
** in the level but not associated with the burial
x mentionned but number unknown
xx numerous mentionned but exact number unknown
fgt. fragments
? associated with the deceased or just in the same level ?
or + or more
F Fossil

| Shells and gastropods | | | | | | | | | | | | | | | | | | | | | | | Stone | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| globular | | | | | | bivalves | | | longs | | »round and sharp« | | | | | | | | | | vulva | | | | | |
| *Littorina obtusata* | *Littorina littorea* | *Theodoxus* sp. | *Tritia neritea* | small gastropod | gastropod *Arianta arbustorum alpicola* | *Cardium edule* | *Glycimeris violascens* or sp. | *Pecten* | *Tympanos-cintus fossil* | *Dentalium (F = fossil)* | *Cerithium* | *Turitella communis* | *Nassa incrassata* | *Nassa reticulata* | *Buccinum corniculum* | *Columbella rustica* | *Melanopsis* | *Fusus (colus)* | *Nassarium circumcintus* | *Phallium* sp. | *Purpura (nucella) lapillus* | *Cypraea* sp., or *Zonaria pyrum* or *Luria lurida* | *Trivia europea* | marl perced disc | stone washer | schist pendant | sea urchin pierced |
| | | | 25 or + | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | 300 | xx | | | | | | | | | | | | | | | | | | 2 | | | | |
| | | | 100 or + | | | | | | | | | | | | | x | | | | | | x | x | | | |
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**Tab. 1** Ornaments in Gravettian burials. Material, shape, numbers of beads for each individual or multiple Gravettian burials found with adornment, based on archaeological records.

***Tab. 1*** *Schmuckelemente aus gravettienzeitlichen Bestattungen. Material, Form, Anzahl der Perlen für jede einzelne oder mehrere der gravettienzeitlichen Bestattungen mit Schmuckelementen, basierend auf archäologischen Aufzeichnungen.*

| Labels | Names of main remains | Site | Location | Country | $^{14}$C age [BP] | Age [cal BP] | Lab.-Nr. | Date of discovery | Bibliography | Burial ? |
|---|---|---|---|---|---|---|---|---|---|---|
| K14 | K14** Martina Gora | Kostenki | Voronej | Russia | 31 700 ± 430 | 38 680–36 260<br>37 987 ± 665<br>38 684–36 262 | OxA-2395-15 | 1918 or 1954 | Fu et al. 2013; Mounier et al. 2020; Seguin-Orlando 2014; Sikora et al. 2017; Pettitt 2011 | X |
| | Mladec 1, 2, 3, 8, 9, I1, I2 | Mladec | | Czech Rep. | 31 190 ± 400 (Mladec 1) direct AMS on tooth, -31 680 + 380, -26 330 + 179 | 36 858–34 461 (Mladec 1) | Vera-3073, Vera-3075, Vera-2736 | 1881–1882 and 1922 | Henry-Gambier 2007, 111 | |
| | Q116-1** | Goyet | | Belgium | | 35 160–34 440 (Q116–1) | GrA-46175 | 1860–1870 | Fu et al. 2016 | |
| S1–4 | Sunghir 1** | Sunghir | Vladimir | Russia | | 33 925–31 820 | | 1964–1969 | Sikora et al. 2017 | X |
| | Sunghir 2** | | | | | 34 600–33 700 | | | | X |
| | Sunghir 3** | | | | | 34 204–33 081 | | | | X |
| | Sunghir 4** | | | | in S2/S3 burial | c. 34/33 000 | | 1964–1969 | | |
| Pavd1 | Pavilland 1 «Red Lady» | Pa-viland | Goat's Hole Cave | England | 28 870 ± 180<br>29 490 ± 210 | 34 163–32 159/<br>34 586–33 240 | OxA-16412, OxA16413 | 1823 | Pettitt 2011; Richards/Trinkaus 2009, quoting Jacobi/Higham 2008 | X |
| | Muierii 1* | Pestera Muieri-lor | Baia de Fier | Romania | 34 000, 35 000, late Aurignacian or early Gravettian | 33 760–32 840 | | 1952 | Henry-Gambier 2007 | |
| | Cioclovina 1* | Cioclovina | Hunedoara, Bosorod | | 28 500 | 32 915 ± 359/<br>33 090–31 780 | OxA-15527 | 1941 | Fu et al. 2016 | |
| K12 | K12** Volkovsaya | Kostenki | Voronej | Russia | 23 600 ± 300/<br>32 700 ± 700 | 32 990–31 840 (on skull), or 33 040–31 890 (layer) | GIN 89/GrN 775 layer : GrA5552 | 1918, 1936/37 | Fu et al. 2013; Fu et al. 2016; Henry-Gambier 2008b | X |
| CM1 to CM5–4 | CM1 »the old man«, CM2, CM3, CM4, CM5-1, CM5-2, CM5-3, CM5-4 | Cro-Magnon | Les Eyzies | France | 27 680 ± 270 | 32 975–31 080 | Beta 157439 | 1868 | Henry-Gambier et al. 2013; Villotte et al. 2019 | X |
| BT1, BT2, BT3 | BT1, BT2, BT3 | Baousso da Torre | Balzi Rossi, Ventimiglia | Italy | Aurignacian or Gravettian | | | 1873 | | X |
| GE5, GE6 | GE5, GE6 | Grotte des Enfants (Fanciulli) | | | Aurignacian or early Gravettian, before 28,1 kya | | | 1901 | | X |
| BG1, BG2, BG3, BG4 | BG1, BG2, BG3, BG4 | Barma Grande | | | Early Gravettian | | | 1884, 1892 | | X |
| DV3 | DV3 | Dolní Věstonice I | Pavlovske Hills, Moravia | Czech Rep. | 30 000–26 000 | | | 1949 | | X |
| DV4 | DV4 | | | | 30 000–26 000 | | | 1925 | | X |

*Continued on the next page*

| Labels | Names of main remains | Site | Location | Country | $^{14}$C age [BP] | Age [cal BP] | Lab.-Nr. | Date of discovery | Bibliography | Burial ? |
|---|---|---|---|---|---|---|---|---|---|---|
| KWA, B, C | KWA*, KWB, KWC + 2 remains? | Krems-Wachtberg | | Austria | 30850/26580 ± 160 | 31250–30690 on skull/31172–30260 (b) | Poz-12920 (b) | 2005–2007 | Fu et al. 2016 | X |
| Vilh1 | Vilhonneur 1 | Vilhonneur | Grotte des Garennes Charente | France | 27010 ± 210 (Rib18)/ 26690 ± 190 (Rib 17) | 31192–30932, 31319–30790 (Rib 18, AMS direct)/ 31032–30767, 31155–30611 (Rib 17, AMS direct) | Beta216141 (Rib 18), Beta 216142 (Rib 17) | 2005 | Henry-Gambier 2007; Foucher 2019 | X |
| S5 | Sunghir 5 | Sunghir | Vladimir | Russia | 26042 ± 182 | 30978 (99,7 %) 29910 | | | Sikora et al. 2017 | |
| DV13, 14, 15 | DV13, 14, 15 | Dolní Věstonice II | Pavlovske Hills, Moravia | Czech Rep. | 26640 ± 110, 24000 ± 900 | 31155 ± 85/ 31070–30670 | GrN-14831/ ISGS1616 | 1986 | Fu et al. 2013; Fu et al. 2016 | X |
| DV16 | DV16** | | | | 25570 ± 280 on charcoal | 30710–29310 | | 1987 | Fu et al. 2016 | X |
| K15 | K15 Gorodsov | Kostenki | Voronej | Russia | 25700 ± 250/ 21720 ± 570 | 30865–29170/ 27788–24191 | GIN 8020/ LE 1430 | 1952 | Henry-Gambier 2008b | X |
| BG5, BG6 | BG5, BG6 | Barma Grande | Balzi Rossi, Ventimiglia | Italy | 24800 ± 800 (BG6) | -31090 –-28090 on metatars (BG6)/ 31699–27075 | OxA-10093 | 1894 | Formicola (2015); De Lumley et al. 2016, | X |
| Pavl1 | Pavlov 1* | Pavlov | Pavlovske Hills, Moravia | Czech Rep. | | 31160–27460/ 31110–29410 | GrN-20391 | 1954–1957 | Fu et al. 2016 | X |
| PagII | Paglicci 15 ou II ou 12 | Paglicci | Rignano Garganico | Italy | 24720 ± 420, 24750 ± 370 | 30279–27729, 30110–27798 | | | | X |
| Cus | L1, L2, L3 | Cussac | Cadouin | France | 25120 AMS direct on rib | 29704–28714, 29335–28981, 29500–28835 | Beta 156643 | 2000 | Aujoulat et al. 2002; Villotte 2019 | X |
| Ost1 | Ostuni 1a,** 1b | Ostuni | Santa Maria di Agnano | Italy | 24410 ± 320, 27614 (b) | 29840–27725 | Gif 9247 (first dating) | 1991 | (a) Palma di Cesnola 2002, 274; (b) Fu et al. 2016 | X |
| Ost2 | Ostuni 2 | | | | | 29310–28640 | | 1991 | Fu et al. 2016 | X |
| Four | Fournol 85* | Fournol | Solutrac, near Fumel Lot | France | 24820 ± 220 | 29108–28620, 29410–28415 on human fgt | Lyon-9985 | 1986–2015/17 | Morala 2017; Villotte et al. 2019 | |
| Mol | Mollet III (MIII 379, Gerona Mollet III SN,4) | Mollet III Cave Serinyà | near Reclau Viver, Mollet, Pau and Arbreda | Spain | 22330 ± 90 direct AMS | 25008–24426 | GrA-43783 | 1972 | Soler et al. 2013 | ? |
| LV1 | Lagar Velho 1 or Lapedo Boy | Lagar Velho | Lapedo Valley | Portugal | 24360 ± 220/ 24860 ± 200 | 29199–27802/ 29951–28538 | OxA8422 / GrA1310 | 1998 | | X |

*Continued on the next page*

| Labels | Names of main remains | Site | Location | Country | $^{14}$C age [BP] | Age [cal BP] | Lab.-Nr. | Date of discovery | Bibliography | Burial ? |
|---|---|---|---|---|---|---|---|---|---|---|
| PagIII | Paglicci 25 or III | Paglicci | Rignano Garganico | Italy | 23470 ± 370, 23040 ± 380 | 28992–26849 | | 1971, 1988/89 | | X |
| Brno 2 | Brno 2 also called »Francouszka street« | Brno | | Czech Rep. | 23680 ± 200 direct dating | 28631–27305 | OxA-8293 | 1885, 1891 | | X |
| AC1 | Arene Candide 1 | Arene Candide | Finale Ligure | Italy | 23440 ± 190 AMS dating on femur | 28258–27207 | OxA-10700 | 1942 | De Lumley et al. 2016, 438 | X |
| Pred | Předmosti 3, 22 | Předmosti | | Czech Rep. | 23340 ± 120 | 27831–27261 | | 1894 | | Multiple |
| Roch | La Rochette 1 | La Rochette | Saint-Léon-sur-Vézère | France | 23630 ± 130 | 27780–27400, 27843–27634, 27962–27516 | OxA-11053 | 1910 | Foucher 2019; Orschiedt 2002 | X |
| Par1-2 | Parabita 1–2 | Veneri Parabita | Apulia | Italy | 22220 ± 360/ 22110 ± 330 | 27677–25637/ 27406–25550 | | 1958 | | X |
| BC1 | Cavillon (Barma del Caviglione) | Cavillon | Balzi Rossi, Ventimiglia | Italy | 28780 ± 560, -22260 ± 270, 22220 ± 320, -20220 ± 260 = env 24000 on shell/like layer D Mochi | -33670–31190, -26610–24930, -26660–24780, 23820–22450 (on shell) | GifA88202/ GifA88317/ GifA 88337/ GifA 88316 | 1872 | De Lumley et al. 2016, 314; 437; 438 | X |
| Mar1 | Le Marronier 1 | Le Marronier | Saint-Martin-d'Ardèche | France | Gravettian | | | 1969 | Onoratini/Combier 1995; Gely 2005 | X |
| Fig1 | Figuier 1 | Figuier | | | Recent Gravettian (Noallien?) | | | 1947 | Slimak Plisson 2008; Quechon 1976; Gely 2005; Onoratini/ Combier 1995 | X |
| GE4 | GE4 | Grotte des Enfants (Francuilli) | Balzi Rossi, Ventimiglia | Italy | 28100 similar to findings from Level 23 Grotte Paglicci, therefore early Gravettian (a) or recent Gravettian burin type Noailles (b) | | | | (a) De Lumley et al. 2016, 314; (b) Palma di Cesnola 2002 | X |
| P1, P2, P3, P4, P5, P6 | Pataud 1–6 | Pataud | Les Eyzies | France | 22000 ± 600 | 28280–24327 | | 1958 | Nespoulet et al. 2013; Nespoulet et al. 2015; Villotte 2019 | X |
| K18 | K18 Khvoiko | Kostenki | Voronej | Russia | 21020 ± 180 | 27840/ 25905–24636 | OxA-7128 | | Richards et al. 2001 Reynolds et al. 2017 | X |
| K2 | K2 Zamiat nin | | | | 20500 ± 110 | 25.1–24.3 kya | OxA-40272 | | | X |
| Mal'ta | Mal'ta 1 | Mal'ta | | | | 24520–24090 | | 1952–1980 | Fu et al. 2016 | X |

* DNA **DNA and phenotypic infos

Early Upper Palaeolithic | Early Gravettian | Middle Gravettian | Recent Gravettian | Late Gravettian | Gravettian

**Tab. 2** Database of Gravettian human remains. Labels, names, location, dates in BP, dates in cal BP, date of discovery for all the burials and individuals remains dated from -34 kya to -24 kya cal BP. In blue, new calibrations made for this study with Oxcal IntCal 20 (intcal10.14c) at 99.7 % in March 2024 from non-calibrated BP date.

***Tab. 2*** *Datenbank der gravettienzeitlichen menschlichen Überreste. Kennzeichnungen, Namen, Orte, Daten in BP, Daten in cal BP, Datum der Entdeckung für alle Bestattungen und Individuen, die zwischen -34 kya bis -24 kya cal BP datieren. In blau sind die neuen Kalibrierungen dargestellt, die für diese Studie auf Oxcal IntCal 20 (intcal10.14c) im März 2024 auf Grundlage nicht kalibrierter BP-Daten vorgenommen wurden (99,7 % Wahrscheinlichkeit).*

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## Source of figures

1 A. Swieder, LDA, after P. Coste; basemap: GTOPO30/SRTM Courtesy of the U.S. Geological Survey (USGS), the National Aeronautics and Space Administration (NASA), and the National Geospatial-Intelligence Agency (NGA), publicly available; water features created using Natural Earth; free vector and raster map data @ naturalearthdata.com
2 P. Coste; after Noiret 2013; Goutas 2013; Djindjian et al. 1999; Otte 2013; Pettitt 2011; Gambier 2008; Delporte 1962; Simonet 2012; Kozlowski 1992; Jaubert 2018
3 map by B. Janzen, LDA; 3B.picture of BT2 in Coste 2016, courtesy of the Musée d'Archeologie Nationale of Saint-Germain-en-Laye, France by the museum photograph in 1970's or 1980's, others pictures of the casts of the burials Malerba/Giacobini 1992; Malerba/Giacobini 2014
4 B. a. from Teschler-Nicola et al. 2020, 2. b. From Svoboda 2010, 58 (photo by J. Svoboda 1986) c. From Maska
5 B. a. © Enfant Sauvage Productions/Arte TV 2021. b. from L. Lartet 1868, 342
6 B. a, c. From N.O. Bader in Trinkaus/Buzhilova 2018. 3C-4C-5C-6C. Drawings from Coste 2016
7 From Coste in prep.; 13–32 Diverses web sources (shells and teeth); 33a Valoch 1996; 33b from Kozlowski 1992, 56–57
8 1–12 From Coste in prep. 1 from White 1993, 295; 2 from Nespoulet et al. 2013; 3–6 Malerba Giacobini 1992; Malerba Giacobini 2014; 7 Teschler-Nicola et al. 2020; 8–9 Cro-Magnon from Baker et al. 2022; 10–11 screenshots from *Ladies and Princes of Prehistory*; 12 © Oxford University Museum of Natural History <https://oumnh.ox.ac.uk/sites/default/files/oumnh/images/media/red-lady-bones-2.png> (08.08.2025); 13 Verneau 1900, 74
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# Reconstructing clothing from Multi-Reference Analyses of personal ornaments found in Palaeolithic burials – three case studies and their implications

Marian Vanhaeren

**Zusammenfassung**

Rekonstruktion von Bekleidung vermittels Multireferenzanalysen von Schmuck aus paläolithischen Gräbern – drei Fallstudien und ihre Aussagekraft

*Kleidung kann durch eine Reihe von Variablen charakterisiert werden – darunter Material, Isolierungsgrad, Herstellungstechniken und Art der Kleidungsstücke, aber auch Farben, Muster, Motive und Accessoires sowie der soziale Kontext des Gebrauchs. Archäologen müssen sehr sorgfältig vorgehen, um prähistorische Kleidung zu rekonstruieren, da diese Variablen nur aus Daten abgeleitet werden können, die meist nur indirekt greifbar sind. Gut erhaltene, geschlossene und ungestörte Primärbestattungen mit noch vorhandenen langlebigen Schmuckgegenständen bieten einige visuelle Eindrücke, die im Zusammenhang mit Kleidung oder Kleidungszubehör entsprechend interpretiert werden können. Auch die Analyse von Gebrauchsspuren auf Schmuckobjekten, die in Gräbern gefunden wurden, kann eine Rekonstruktion der visuellen Eindrücke von Perlarbeiten ermöglichen, die einen integralen Bestandteil der dortigen Kleidungsstücke bilden, oder von anderen Gegenständen, die mit der Bestattung verbunden sind. Dieser Beitrag soll eine Momentaufnahme solcher Wirkungen und Analysen liefern, um zu untersuchen, wie persönlicher Zierrat in Bestattungskontexten zur Rekonstruktion des Aussehens von Kleidung beitragen kann.*

**Schlagwörter** Ästhetik, Gebrauchsspurenanalyse, Perlen, Miniaturisierung, Kinder

**Summary**

*Clothing can be characterised by a number of variables – including material, level of insulation, manufacturing techniques, and items of clothing, but also colours, patterns, motives and accessories, as well as the social context of use. Archaeologists must put a great deal of effort into reconstructing prehistoric clothing as these variables can only be inferred from data that are mostly indirect. Well-preserved, closed and undisturbed primary burials with durable decorative items still in place offer some visual impressions that can be interpreted in regard to clothing or clothing accessories. Also, the analysis of use-wear patterns on personal ornaments found in graves may allow reconstruction of the visual impacts of beadwork forming an integral part of a garment or of other items associated with the burial. This paper aims to provide a snapshot of such impressions and analyses to investigate how personal ornaments in burial contexts can contribute to the reconstruction of the appearance of clothing.*

**Keywords** Aesthetics, use-wear analysis, beads, miniaturisation, children

## Introduction

Primary closed burials offer crucial opportunities to investigate how personal ornaments were displayed on individuals of a specific age and sex, albeit in the specific context of funerary customs[1]. Most of these personal ornaments can be seen as clothing accessories (cf. e.g. Hansen 2004), i.e. decorative items supplementing an individual's outfit, and their location in the grave may make it possible to associate them with specific body parts and clothing items. Well-preserved primary closed undisturbed burials are, however, relatively rare in the Palaeolithic, and for inferring similarities and differences or diachronic and geographic trends, one has to include ornaments found in settlement sites, which are more numerous, more continuous in time and less localised on the Eurasian territory than burials[2]. Also, research on the topic[3] shows that a better understanding of clothing can be reached if multiple variables of clothing are investigated, such as suitable materials providing insulation, manufacturing techniques, clothing items, displayed colours, patterns, motives and accessories, auditory and olfactory properties, and of course the physical and social

1 Cf. e.g. McGregor 1943; Tarlow/Nilsson 2013; Lullo/Wallace 2019; Baysal/Sağlamtimur 2021; Baadsgaard 2024.

2 Cf. e.g. Taborin 1993; Taborin 2004; Vanhaeren/d'Errico 2006; Álvarez/Jöris 2008; Baker et al. 2024.

3 Cf. e.g. Hansen 2004; DeMello 2007; Gilligan 2010, 2023; Grömer/Pomberger 2023; Baadsgaard 2024; Nowell/Cooke 2024; d'Errico 2024.

characteristics of the wearer as well as the social context of use. Mirroring the complexity of factors influencing clothing, the investigation of these variables requires comparative data and information from different kinds of reference collections, including not only archaeological and experimental ones but also ethnographic, human ethological and aesthetical ones. This contribution aims to illustrate how clues for informed impressions of prehistoric outfits can be obtained through such a holistic approach.

## Multiple variables of clothing potentially visible from personal ornaments found in burials

Even though a complete picture of all clothing variables remains out of reach, a preliminary frame of reference may allow for more systematic future investigations.

Most obviously, personal ornaments found in closed undisturbed primary burials can be associated with clothes or clothing accessories worn by an individual of a specific sex and age, i.e. male or female, baby, toddler, child, adolescent, adult, in a funerary context at a specific place in a specific time. If multiple contemporaneous burials of younger and older individuals of both sexes are available, regional or supra-regional recurrences and variability according to age and sex can be investigated.

Ideally, personal ornaments found in closed undisturbed primary burials can also be associated with specific anatomical parts and, from there, potentially to the presence and underscoring of specific segments of clothing.

The natural environment and cultural context of the burial may, in addition, provide clues as to the type of materials and techniques that potentially could and should, in the light of prevailing environmental conditions (cf. e.g. Gilligan 2010; Gilligan 2023), have been used for clothing (e.g. hides, fabric, pigment, quillwork, beading and so on).

Finally, the inherent characteristics of the personal ornaments may offer insights regarding the colours, patterns, and designs that were displayed. Theoretically, these are limited by the available raw materials and techniques and the imbrication of the constituent parts. Given that personal ornaments do not primarily fulfil a utilitarian purpose but, per definition, are meant as means of communication, it can additionally be postulated that their displays aimed to follow the so-called ›principles of art‹ (cf. Arnheim 1954; Collingwood 1958).

## Personal ornaments, beauty, aesthetics, and the ›principles of art‹

Research on aesthetics identifies some principles that are beneficial for the transmission and impact of visual information[4]. These principles, often intertwined and interdependent, play with components, e.g. lines, shapes, colours, values, forms, textures, and spaces, to create compositions with elements such as novelty and surprise, equilibrium between the parts and the whole (i.e. balance), symmetry, repetition, exaggeration, emphasis, movement, contrast and shared emotions.

›Principles of art‹ are evident in present-day and ethnographically documented ornaments and can also be found, for example, in the c. 75 000-year-old Nassarius shell ornaments from Blombos Cave, Western Cape, South Africa[5]. Even if the specific manifestations of beauty differ according to socio-cultural groups, the use of the »principles of art« and the search for beauty and aesthetics have a universal character (e.g. Herskovits 1947; Brown 1991; Sütterlin et al. 2014) and should therefore be considered in potential reconstructions of past clothing accessories and clothing.

## Examples of Upper Palaeolithic personal ornaments found in burials

### La Madeleine child burial

The burial of the c. 2–4-year-old (Henry-Gambier et al. 2000) La Madeleine child was discovered in 1926 by D. Peyrony in the La Madeleine site, Dép. Dordogne, located in southwestern France (Peyrony 1926, 1927; Capitan/Peyrony 1928). The child burial was directly dated to 10 190 ± 100 BP (GifA 95457; Henry-Gambier et al. 2000). An old drawing (Capitan/Peyrony 1928, 122) of the burial shows that ornaments were found on the head and around all the child's joints (Fig. 1a). The child has been buried with up to ten different bead types (Taborin 1993; Vanhaeren/d'Errico 2001). Among them are 2 red deer canines, 2 fox canines, 1 perforated phalanx of a rabbit or hare, 1 fish vertebra, 1 *Glycymeris*, 36 *Turitella*, 20 *Tritia neritea*, 160 *Neritina*, and, most spectacular in number, 1314 *Dentalium* shells (cf. Fig. 1b). Unfortunately, specific information on the location of each of these personal types within the grave seem to be lost.

The analysis of the La Madeleine ornaments in the light of several reference collections, including morphometrics of natural shells from present-day and fossil seashores, morphometrics of archaeological shells found in adult burials, breakage patterns due to natural processes and to experimental flexing, sawing and sewing, maximum diameters of archaeological needles from the La Madeleine site, and a small sediment bloc of the burial that preserved 5 *Dentalium* shells in place, provided interesting insights into Late Palaeolithic beadwork practices (Vanhaeren/d'Errico 2001).

Morphometrics show that La Madeleine *Dentalia* are significantly shorter than those from present-day and fossil natural sources. They are also comparatively shorter than those in relative contemporary burials of adults. The La Madeleine *Dentalia* are not only short but also have quite large openings at both ends, indicating that they were broken in order to obtain short and large cylindrical beads. The

4 Cf. e.g. Arnheim 1954; Collingwood 1958; Rentschler et al. 1988; Eibl-Eibesfeldt 1988; Dissanayake 1980; Dissanayake 1992; Dissanayake 2009; Eibl-Eibesfeldt/Sütterlin 2008; Ishiku/Zeki 2011; Changeux 2012; Conway/Rehding 2012; Bohrn et al. 2013; Sütterlin et al. 2014; Mendoza Straffon 2014; Krentz/Earl 2013; Mouclier et al. 2023 and references therein.

5 Cf. e.g.; Cole 1975; Schoeman 1983; Dubin 1987; Dubin 1999; Sciama/Eicher 1998; Vanhaeren 2014; Mouclier et al. 2023.

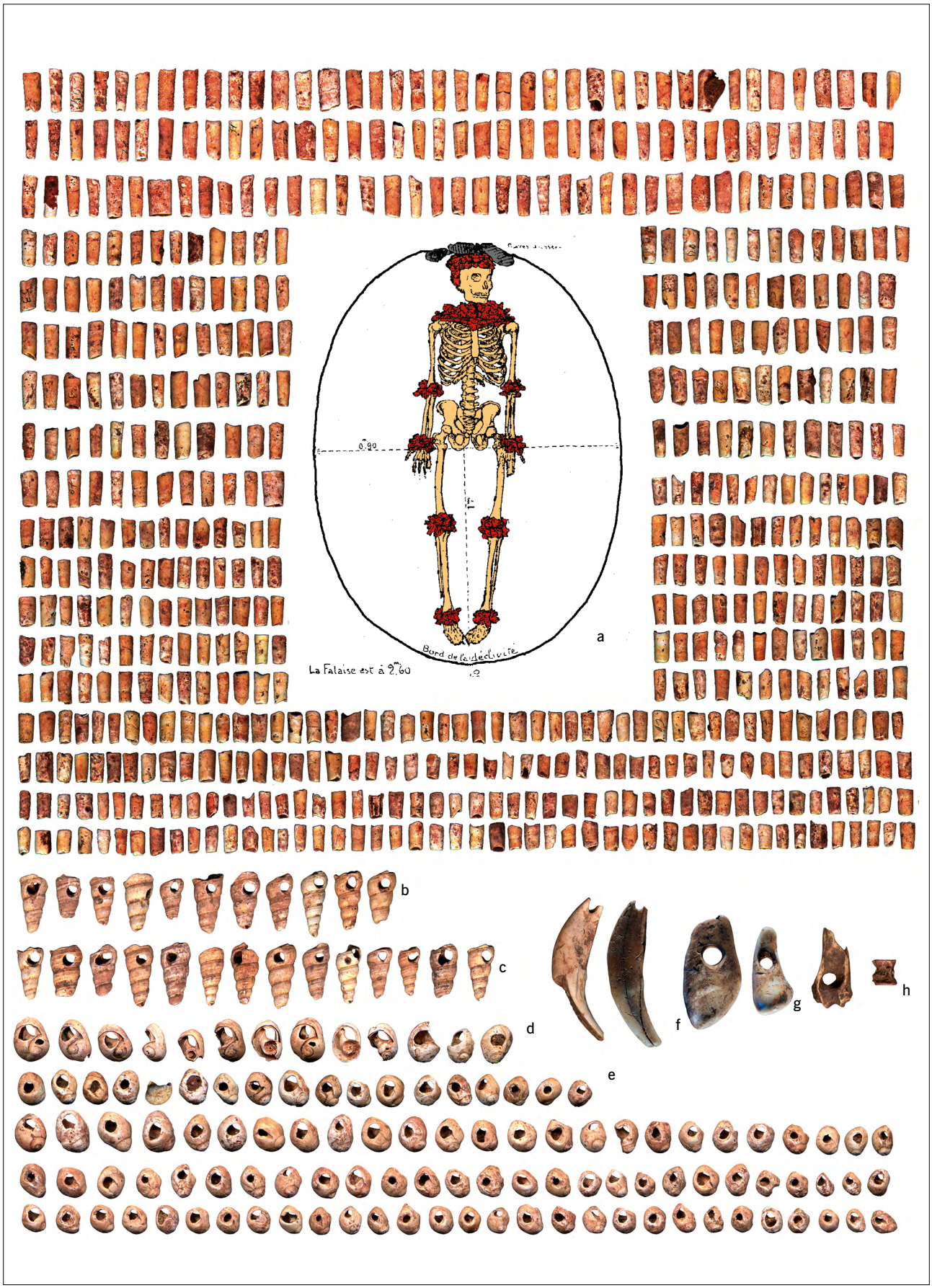


**Fig. 1a–f** a Sketch of the La Madeleine child burial indicating the arrangement of the personal ornaments; b selection of associated *Dentalia*; c *Turitella* shells; d *Tritia neritea* shells; e *Neritina* shells; f fox canines; g red deer canines; h *Glycymeris* shell. No scale.

***Abb. 1a–f*** *a Skizze der Kinderbestattung von La Madeleine mit der Anordnung der zugehörigen Schmuckelemente; b Auswahl von* Dentalia*; c* Turitella-*Gehäuse; d* Tritia neritea-*Gehäuse; e* Neritina-*Gehäuse; f Fuchseckzähne; g Rothirscheckzähne; h Glycymerismuschelschale. O. M.*

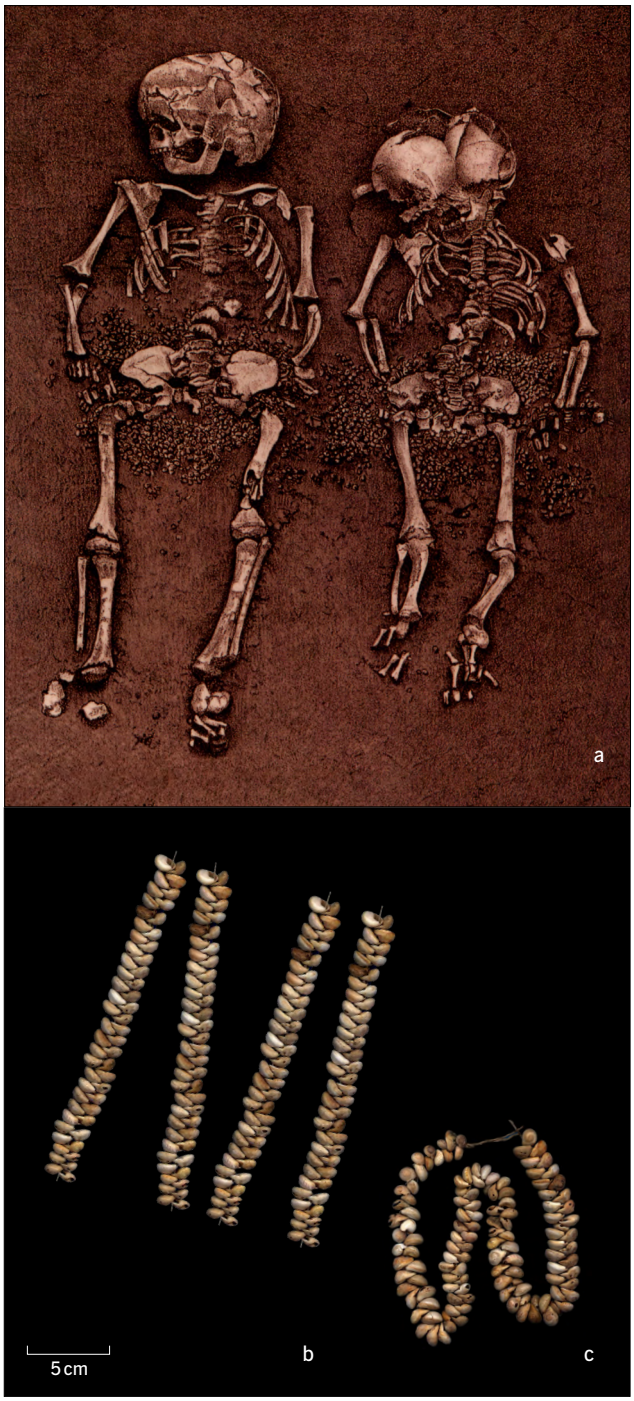


**Fig. 2a–c** a Grotte des Enfants double child burial with the location of the associated *Tritia neritea* beads. b–c Modern *Tritia neritea* shell beads strung on strings.

***Abb. 2a–c*** *a Grotte des Enfants. Doppelkindergrab mit der Lage der zugehörigen Perlen aus* Tritia neritea-*Gehäusen. b–c Rezente* Tritia neritea-*Gehäuse aufgereiht an Schnüren.*

analysis of the bead morphologies indicates that the *Dentalium* shells were indeed broken through flexion and sawing and most likely embroidered as indicated by diagnostic breakage patterns on the minimal diameter openings due to forced passage of a needle and the fact that the smallest needles found at the site have a maximum diameter that can pass through the openings of the *Dentalia* found within the child burial. Notches visible on some specimens and the associated longitudinal flat facets suggest that they were applied to clothes. Notches and facets likely result from friction with thread and cloth respectively. It is probable, given their similar size, that the *Dentalia* were sewn one next to the other as also supported by the sediment bloc that contains 5 *Dentalium* shells still arranged side by side. Undoubtedly, at La Madeleine, people invested a surprising degree of attention, time, and specific skill in collecting, manufacturing and embroidering these small *Dentalium* shells on the child's clothes.

Interestingly, the same trend towards miniaturisation is observed in the other shell beads associated with this child burial. The *Turitella* shells are composed of small specimens only. The *Glycymeris* sp. bivalve shell from the burial is also tiny. Unless taxonomic or environmental reasons underly observed differences in *Tritia neritea* shell size, the same tendency seems also true for the *Tritia neritea* shells at La Madeleine as well as for the *Tritia neritea* shells found in the double burial (GE1 and GE2) of the Grotte des Enfants in Liguria, Italy (Fig. 2a–b), directly dated to c. 11 130 ± 100 BP (GifA 94197; Rivière 1887; Henry-Gambier et al. 2001; Vanhaeren/d'Errico 2003a). Remarkably, at the relative contemporaneous settlement site of Pincevent, red, white and yellow disk-shaped beads come in two clearly distinct sizes: large and small (Vanhaeren 2006a; Vanhaeren 2006b), suggesting what may be a more widespread trend towards the manufacturing of special miniature beadwork for children.

Intriguingly, the experimental reproduction of the *Tritia neritea* found in vertical alignments around the pelvises of the two children in the Grotte des Enfants double burial, discovered in 1874 by E. Rivière (1874; Rivière 1887), produces a tinkling sound (Vanhaeren 2003). The fact that sound may have played a role in the design of beadwork (Shaham/Belfer-Cohen 2017) is also suggested by the experimental reproduction of the moose teeth beadwork from the Mesolithic burial 127 at Yuzhniy Oleniy Ostrov, Karelia Region, Russia (Rainio et al. 2021).

That specific morphological attributes also played a role in beadwork made from animal teeth is also suggested by the fact that the two red deer canines found associated with the La Madeleine child correspond to two left canines, one from a stag and one from a hind, and that the same is true for the fox canines in the burial, which both correspond to left canines, one upper and one lower canine (Vanhaeren/d'Errico 2001).

Tentatively, one could infer from the drawing with the location of beads on the skeleton that the La Madeleine child had clothes with decorated head covering (or hair), neckline (either or both as a necklace or on the neckline and/or epaulettes), and sleeves and legs (either pants, leggings or boots). In this respect, a similarity can be seen with the positioning of ivory beads in the Sungir burials, Vladimir Oblast, Russia (Bader/Lavrushin 1998). The absence of a hemline is worth noting; it may have been absent, not decorated or decorated with perishable materials. Alternatively, the hemline came to the child's knees and was decorated only at these two spots. A phalanx of Lagomorpha may suggest that it was used in connection with the fur of this animal, known to be relatively thin and soft, which are qualities especially sought for in baby clothes (cf. e.g. Hall et al. 1994). Through

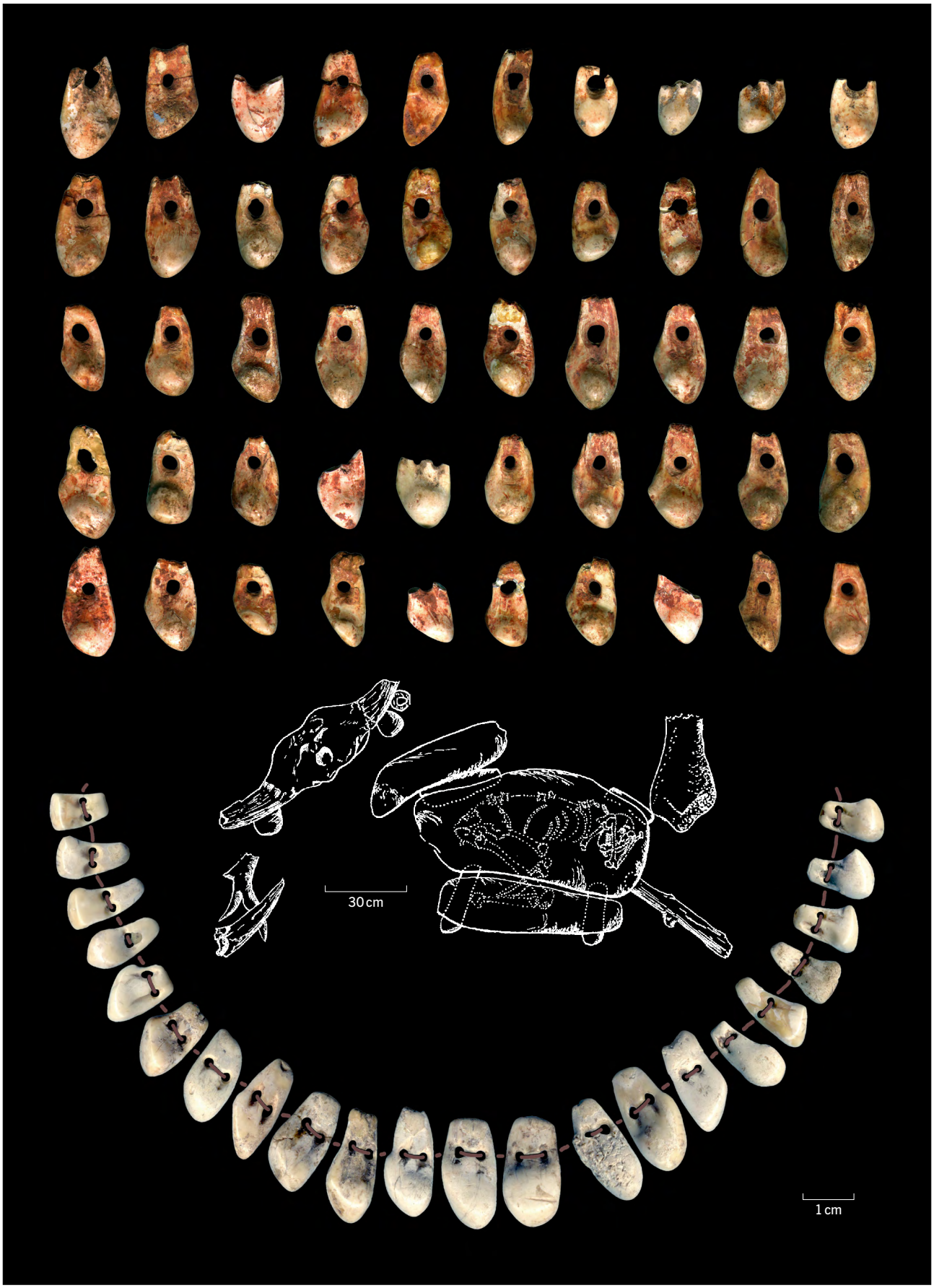


**Fig. 3** Plan (centre) of the Saint-Germain-la-Rivière burial and perforated red deer canines associated with the burial (top) and the so-called ›Mirande necklace‹ (bottom).

***Abb. 3*** *Plan (Mitte) der Bestattung von Saint-Germain-la-Rivière und gelochte Rothirscheckzähne, die im Kontext der Bestattung (oben) und der sogenannten »Mirande-Halskette« (unten) gefunden wurden.*

**Fig. 4** Symmetrical display of the red deer canines and *Littorina obtusata* shells associated with the Lagar Velho child burial. Scale bar = 1 cm.

***Abb. 4*** *Symmetrisches Arrangement aus Rothirscheckzähnen und Gehäusen der Meeresschnecke* Littorina obtusata *aus der Kinderbestattung von Lagar Velho. Maßstabsleiste = 1 cm.*

the combination of results from comparative analyses of personal ornaments found in burials and reference collections, it is possible to infer that personal ornaments were sewn on in a miniaturised version of shells worn by adults and that – at least the *Dentalium* shells – were most likely sewn one next to the other in a vertical position on clothing material. If principles of art were applied, the pattern of vertically juxtaposed *Dentalium* stubs, which are the most numerous, may have been repeated in these various locations, and larger items displayed in central and symmetrical positions. In sum, the impressive, rich ornaments in the grave of the La Madeleine child, which obviously were manufactured in specifically miniaturised ways and thus very different in size than normally seen in adult burials, seem to indicate strong affection, possibly the emotion of parental love and the very high investment in this offspring (cf. e.g. Barba 2021).

## Lady of Saint-Germain-la-Rivière burial

The burial of the Lady of Saint-Germain-la-Rivière, Dép. Gironde, France (Fig. 3) was discovered in 1934 by R. Blanchard (Blanchard et al. 1972) and is now directly dated to c. 15 780 ± 200 BP (GifA 95456; Henry-Gambier et al. 2002). The Lady had been buried with three bead types, among which were 72 red deer canines found in the chest region (Blanchard et al. 1972; Vanhaeren/d'Errico 2003b).

Natural present-day reference collections allow us to identify stag and hind canines, right and left teeth and teeth originating from the same animal (cf. e.g. d'Errico/Vanhaeren 2002). Comparison with these reference collections shows that the red deer teeth of the Saint-Germain-la-Rivière burial belonged to 66 animals, with very few paired teeth, nevertheless more or less the same number of left and right teeth, and a preference for teeth from stags, which are larger than those from hinds (Vanhaeren/d'Errico 2003b). Discrete use-wear was observed, yet not systematically analysed in the light of diagnostic experimental reference collections. In contrast, use-wear on the red deer teeth composing the so-called ›Mirande necklace‹ (cf. Fig. 3; Garde 1946), named after the excavator who found it at the Saint-Germain-la-Rivière settlement site, suggests stringing, displaying of the labial side, and a symmetrical composition (Vanhaeren/d'Errico 2003b).

That laterality played a role is also suggested by the fact that the two red deer canines found associated with the La Madeleine child correspond to two left canines. The same principle accounts for the fox canines in the burial, which both correspond to left canines. All red deer canines from the Magdalenian VI horizon of the La Madeleine site are also left teeth.

In the light of the presented reference collections, analysis of the red deer canines from well-preserved primary burials, such as those from the Gravettian, may permit us to reach better visual impressions of prehistoric outfits.

## Lagar Velho child burial

The Lagar Velho child, Leiria District, Portugal, directly dated to 23 950 ± 150 BP (OxA-43547; Linscott et al. 2025), was discovered in the central region of Portugal at the base of a limestone cliff (Zilhão/Trinkhaus 2002). Excavations (cf. Fig. 3a–b) revealed that terrace works displaced the child's cranium (cf. Fig. 3c) but left its postcranial remains in place (Zilhão/Trinkhaus 2002; Duarte 2002). Two red deer canines were found near the fragments of the cranium, one *Littorina obtusata* shell near the child's cervical vertebra and another *Littorina obtusata* shell in the same square metre as the first shell but a few centimetres above the skeleton (Zilhão/Trinkhaus 2002; Duarte 2002; Vanhaeren/d'Errico 2002).

Application of the model for estimating the age and sex of red deer canines (d'Errico/Vanhaeren 2002) to the red deer canines associated with the Lagar Velho cranium made it possible to identify the four teeth as a right and a left canine of two different old hinds and a right and a left canine of two different stags – one young and one adult individual. Considering the size of the canines, it is striking that, although they do not come from the same animal, the two hind canines, on the one hand and the two stag canines on the other hand, have such surprisingly similar sizes compared to the variability of red deer canines of the same sex

available from other Upper Palaeolithic burials of Europe (Vanhaeren/d'Errico 2002). The other striking feature is that, apparently, the beadmaker has chosen large male canines and small female canines.

Contextual information and the technological, morphometrical, and microscopical analysis of the ornaments (Vanhaeren/d'Errico 2002) suggest that the red deer canines were probably arranged with their crowns downward on the forehead of the Lagar Velho child. This arrangement is almost identical to that observed on the Pagglici woman, Apulia, Italy (Ronchitelli et al. 2014), only here, the crowns of the deer teeth were apparently oriented upward.

The way in which the canines were arranged certainly took into account the aforementioned features, namely 1) the opposite lateralisation of the canines of the same sex, 2) the morphological similarity of the canines of the same sex and 3) the exaggerated size difference between the canines of opposite sex. These ingredients were probably used to create a symmetry that enhanced the visual impact of the beadwork (Fig. 4).

## Discussion, conclusion and perspectives

From the perspective of ethnoarchaeology, highly valuable grave goods like clothes and lavish ornaments allow us to fathom the strong emotions released by the death of a much-loved person. The lyrics of mourning songs from Melanesia and other parts of the world speak of the devastating loss (cf. e.g. Schiefenhövel 2014 and references therein) and allow us to envisage, thousands of years later, the scenes of death and burial. The Upper Palaeolithic personal ornaments examined form an integral part of clothing and surely interacted to reach the desired visual and social impact. The three case studies show that multiple elements, including size, laterality, and probably also sound, played a role in prehistoric beadwork. The La Madeleine and Lagar Velho case studies suggest that children can wear the same type of ornaments as adults or miniature versions thereof. Analysis of the inherent characteristics of personal ornaments found *in situ* on buried skeletons and consideration of the so-called ›principles of art‹ (cf. e.g. Vanhaeren 2014: search for novelty and surprise, equilibrium between the parts and the whole, symmetry, repetition, exaggeration, colour play, and shared emotions) may help to obtain informed visual impressions of clothing in the prehistoric past. Multiple cross-linked reference collections facilitate a better reconstruction of how these principles were implemented, related to age and sex, social status, relationship to, and care received by family or other members of the social group, and perhaps also the physical appearance of their wearers in time and space.

## Acknowledgements

Thanks are due to the organisers and participants of the 17th Archaeological Conference of Central Germany »A Stone Age History of Clothing« for the opportunity to present this work and for the many interesting discussions. This contribution further benefited from the constructive reviews by Olaf Jöris and Oliver Dietrich, and the support of French-German Procope program (French Partenariat Hubert Curien (PHC) 2024 Project No. 50971QG), funded by the French Ministry for Europe and Foreign Affairs, the French Ministry for Higher Education and Research and the German Academic Exchange Service (DAAD).

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## Source of figures

1 a after Capitan/Peyrony 1928, 122; b–h Vanhaeren/d'Errico 2001
2 a after Rivière 1887; b–c after Vanhaeren 2003
3 centre after Blanchard et al. 1972; top and bottom: after Vanhaeren/d'Errico 2003b
4 after Vanhaeren/d'Errico 2002, 155 Fig. 10,1

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# Interpreting clothing culture in late Mesolithic burials of Northern Europe based on animal tooth ornaments

Kristiina Mannermaa and Riitta Rainio

**Zusammenfassung**

Interpretation der Bekleidungskultur in spätmesolithischen Bestattungen Nordeuropas anhand von Tierzahnornamenten

*Tierzahnanhänger waren die wichtigsten Schmuckstücke der spätmesolithischen Menschen in Nordosteuropa. Die Anhänger hatten verschiedene Funktionen, wie zum Beispiel Verzierung, Schutz, Ausdruck der Identität und Klangerzeugung. In diesem Beitrag untersuchen wir Tierzähne in Gräbern als Indikatoren für Kleidung und Accessoires wie Kopfbedeckungen, Gürtel, Rasseln und Masken. Unser Material besteht aus Zähnen von eurasischem Elch* (Alces alces), *europäischem Biber* (Castor fiber) *und Braunbär* (Ursus arctos) *aus dem spätmesolithischen Bestattungsplatz Yuzhniy Oleniy Ostrov in Karelien, Nordwestrussland.*

**Schlagwörter** Mesolithische Gräber, Tierzahnanhänger, Kleidung, Kopfbedeckung, Gürtel

**Summary**

*Animal tooth pendants were the most important ornaments for the late Mesolithic people occupying north-eastern Europe. Pendants had various functions, such as ornamentation, protection, expression of identity, and sound production. In this paper, we study the animal teeth in graves as indicators of clothing and accessories like headgear, belts, rattles and masks. Our material consists of teeth from Eurasian elk* (Alces alces), *European beaver* (Castor fiber ) *and brown bear* (Ursus arctos) *from the late Mesolithic hunter-gatherer burial site Yuzhniy Oleniy Ostrov in Karelia, north-western Russia.*

**Keywords** Mesolithic graves, animal tooth pendants, clothes, headgear, belts

## Introduction

Furs and skins of mammals, birds, and fish were materials commonly used for clothing in the Mesolithic. Such soft materials are perishable and prone to rapid decay, leading to the current situation where scholars rarely have much evidence of clothes from the Stone Age (see e.g. Gilligan 2018). Bones and especially teeth survive better, and tooth artefacts have been found in many Stone Age graves in northern Europe. Animal teeth are the skeletal elements most frequently used for making pendants in the Stone Age. Previous research suggests several functions for tooth pendants in addition to aesthetic or decorative realms. They could have been used for ornaments, for embroidery on clothes or as part of jewellery, and they can carry symbolic and magical meanings. For example, P. Vang Petersen (2016) suggests that the main purpose of tooth pendants was protection. According to C. M. Taksami (2001, 12), the peoples of Siberia historically used teeth as protective amulets, for example, placing a bear tooth at the foot of a child's cradle. The Nenets of North Siberia hung polar bear *(Ursus maritimus)* and grey wolf *(Canis lupus)* canines from their belts to protect them from evil spirits, as a cure for pain and to promote success (Ermolova 2005, 197). R. Rainio et al. (2021) have shown that a remarkable sound is produced by sets of teeth from Eurasian elk *(Alces alces)* when they are struck against each other, concluding that such sets were used as musical instruments in ceremonies.

Most animal teeth found in the Late Mesolithic (c. 8200–8000 cal BC) cemetery at Yuzhniy Oleniy Ostrov (YOO) (north-western Russia) had been fashioned into pendants. Some of the elk teeth are without any human-made and visible attachment system, but earlier research suggests that they were also attached to a cloth or wrap, but the attachment system was different (Mannermaa et al. 2021; Rainio et al. 2021).

In the only major publication analysing the YOO burials and their inventories, N. N. Gurina (1956, 187) concluded that the presence and location of animal tooth and bone pendants indicated that the people using the YOO cemetery buried their dead in warm clothes. She used elk teeth to interpret the costumes' appearance, assuming that the ornaments were originally attached to leather or fur clothing. Gurina suggested that both men and women mostly wore long-sleeved dresses or coats, which extended slightly below the knees but never reached the feet. She also mentioned that some graves contained evidence of footwear and headdresses (Gurina 1956, 189; 256). Furthermore, she noted that the men buried in the YOO cemetery wore elk teeth sewn onto the sleeves and chest area and that more belts can be observed in female than in male burials. Otherwise, N. N. Gurina did not observe any biological sex-related aspects of clothing.

In this paper, we take a second look at the locations of the teeth in the YOO graves and propose interpretations

**Fig. 1a–c** Animal tooth pendants from the Yuzhniy Oleniy Ostrov cemetery, Republic of Karelia (Russia). a Eurasian elk *(Alces alces)* incisors from a triple grave 55–57 (MAE 5716-184); b A brown bear *(Ursus arctos)* canine from grave 118a (MAE 5716-566); c Eurasian beaver *(Castor fiber)* incisor plates from a triple grave 55–57 (MAE 5176-183).

***Abb. 1a–c*** *Tierzahn-Anhänger aus dem Gräberfeld von Yuzhniy Oleniy Ostrov, Republik Karelien (Russland). a Schneidezähne des Elchs* (Alces alces) *aus dem Dreifachgrab 55–57 (MAE 5716-184); b Eckzahn eines Braunbären* (Ursus arctos) *aus Grab 118a (MAE 5716-566); c Schneidezahnplatten des Bibers* (Castor fiber) *aus dem Dreifachgrab 55-57 (MAE 5176-183).*

regarding what kinds of clothes, garments or accessories the teeth might have adorned. We use new biological sex identifications of the dead proposed by Batanina et al. (in prep.), which combine morphological estimations and molecular analysis (peptides and DNA).

## Material and methods

The Yuzhniy Oleniy Ostrov (YOO) cemetery was excavated more than 80 years ago, and the artefacts have been studied by various researchers over the years (e.g. Mannermaa et al. 2021; Rainio et al. 2021; Mannermaa et al. 2022). The most detailed description of the burial inventory of 177 burials was published in 1956 by archaeologist N. N. Gurina, who also participated in the excavations. In total, the YOO inventory comprises almost 6000 animal tooth pendants. According to N. N. Gurina (1956), 4372 of them are made from Eurasian elk, 1155 from Eurasian beaver *(Castor fiber)* and 170 from brown bear *(Ursus arctos)* (Fig. 1). In addition, a few teeth of domestic dog *(Canis familiaris)*, grey wolf, wild reindeer *(Rangifer tarandus)* and wild boar *(Sus scrofa)* are present. Eurasian elk tooth pendants have been found in 82 separate burials, often

in great numbers. The number of elk teeth can be as high as several hundred per grave, whereas the numbers of beaver and bear teeth are much lower. Animal teeth can appear side by side in tight rows, in row-like formations on the skull, neck, arms, chest, pelvis, thighs or feet of the deceased, or in more scattered patches. The garments and the suspension loops for pendants have decayed in the ground, but researchers have proposed that the pendant rows or formations represent fringes or decorations on garments or accessories.

Previous research has shown that systematic attachment methods were used on tooth pendants at the YOO cemetery (Gurina 1956; Mannermaa et al. 2021). All Eurasian elk teeth were fashioned into pendants by making a groove or grooves in the proximal part of the root, while the brown bear teeth either show grooves or perforations. Eurasian beaver tooth pendants were made by cutting the tooth longitudinally into halves and using the enamel part as a pendant. They can have bilateral grooves on either one or both ends. R. Rainio et al. (2021) studied a sample selection of elk teeth in detail and concluded that grooves in each grave were made somewhat systematically, possibly by one person using different tools. They likewise concluded that the string forming the loop must have been quite thin, judging from the depth of the grooves in many teeth. Although the depth, breadth and number of grooves on teeth varied, they usually allowed for a durable hold (Mannermaa et al. 2021).

The unbroken crowns of most elk teeth show severe pitting and strong polishing, which can be associated with the general wear from carrying and wearing the pendants. It indicates that they were used before being placed into a grave (Rainio 2021, 648). Pendants were not only grave goods; they were also carried extensively and worn in contact with soft and solid materials, likely during a considerably long period before interment. Most likely, garments were owned and used by the deceased person.

Attachment types on individual pendants can offer information as to whether they were attached tightly, loosely, or perhaps not attached at all. Individual teeth were not investigated for this study, and we cannot know precisely what kind of attachment was made for each tooth. Neither have we investigated the precise location of each individual tooth in the grave – a simple reason for this decision is that the original documentation did not provide enough detail to have allowed for such an investigation. In addition, the number of teeth belonging to each species in the graves was generally not considered.

The body positions of the deceased at the YOO cemetery are relatively homogeneous, but some variation does exist. The deceased are mostly placed on their back, but in some cases, they lie slightly or completely on their sides. In four burials the buried was placed in a leaning position. The head may have been turned to the right or left. The arms may be bent, with hands resting on the abdomen, or they can be straight, lying parallel to the sides of the body. The position in which the deceased was lying was not considered in this study, with a few exceptions: we registered whether the face was directed to one side to a remarkable degree.

Artefacts or human skeletal elements found in graves may have moved from their original position due to the decomposition of the soft parts of the body and/or the garments. Despite this fact, here we do not consider whether the objects may have moved from their original position during and/or after decomposition of the body (i.e. archaeothanatology). The deceased was buried in a leaning position in at least four of the graves (graves 25, 68, 100, 125 and possibly 123). In such cases, the material may have slid towards the feet as a result of gravity.

In this article, the species, type, number and location of animal teeth in the YOO burials were studied, based on the burial descriptions and drawings provided by N. N. Gurina (1956, Appendix 1). The data retrieved were drawn with simple symbols and relative accuracy on a plan (Fig. 2), showing a total of 82 burials. On the plan, the body size and body position of the deceased were schematically plotted to enhance the comparability of burials and burial equipment. The plan summarises a large amount of information and enables a general examination of the burials and their tooth finds. Since the original purpose of the plan was to summarise information for our research on Eurasian elk tooth pendants, it comprehensively shows the graves with teeth from this species. Although brown bear and Eurasian beaver teeth are also marked on the graves, it should be noted that around 20 graves that exclusively contained teeth from these species are missing from the plan. Furthermore, while the number of Eurasian elk teeth is given precisely, the number of bear and beaver teeth is only very roughly indicated. The purpose of this article is to show the preliminary results of our research on ornaments and clothes based on a study of elk tooth pendants. The type of burial, i.e. single or multiple burials, preservation stage of the skeletal remains, or the age of the deceased individual were not considered in our analysis.

## Results

Our analysis of the simplified location of pendants shows that many graves have complex constellations and contain many animal teeth but also that some graves contain just one or a few animal teeth (Fig. 2). The locations of animal teeth vary remarkably, indicating that individuals received not only differing numbers of teeth from different species but also that the teeth were attached to clothes, garments or ornaments in varying ways.

## Eurasian elk teeth

Eurasian elk teeth are usually found in sets on all parts of the skeleton. Their number varies from one to 303 in different graves. 27 graves contain just a few (1–7) elk teeth, clustered on one spot of the skeleton. For example, one or two elk teeth were found by the right hand of the deceased in graves 20 and 21.

15 graves contained more than 100 Eurasian elk teeth. Five of these graves contain a deceased male, two a probable male, four a female and one a probable female.

In graves with more than 100 Eurasian elk teeth, the pendants are usually found on all parts of the body. A

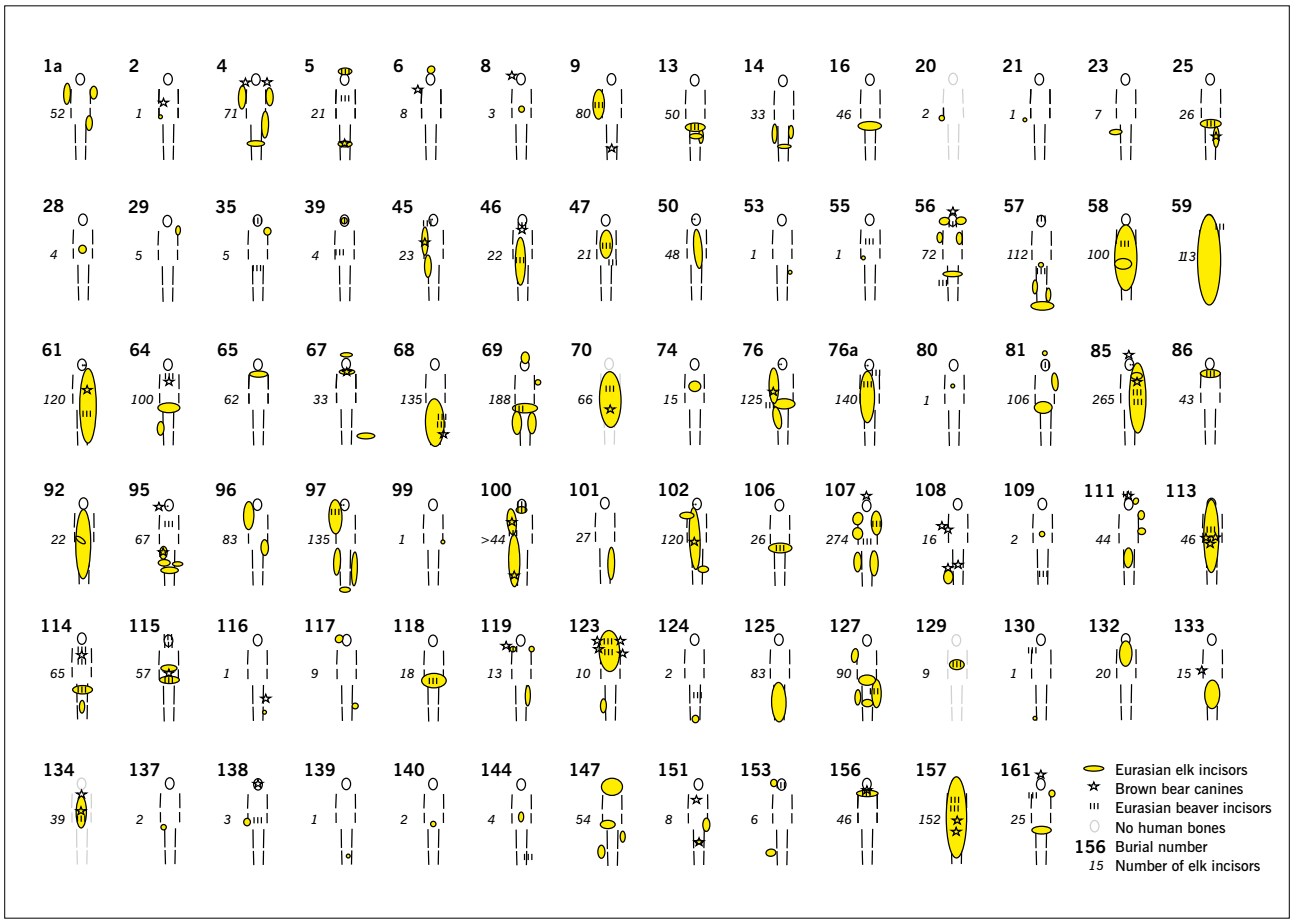


**Fig. 2** Location of the incisors of Eurasian elk, canines of brown bear and Eurasian beaver tooth plates at Yuzhniy Oleniy Ostrov cemetery, Republic of Karelia (Russia). Only graves including Eurasian elk teeth are presented. The grave numbers and number of Eurasian elk teeth are indicated.

***Abb. 2*** *Lage der Elchschneidezähne, der Braunbär-Eckzähne und der Biber-Zahnplatten auf dem Gräberfeld Yuzhniy Oleniy Ostrov, Republik Karelien (Russland). Es werden nur Gräber mit Elchzähnen gezeigt. Die Grabnummern und die Anzahl der Elchzähne sind angegeben.*

good example is grave 107, where 274 Eurasian elk teeth are concentrated on the shoulders, the right arm and the legs, giving the impression that elk teeth were attached to a garment that covered the entire body. Grave 68 is an exception, as all 135 elk teeth are concentrated in the area of the lower body. The grave is one of the leaning burials, though, and so the teeth might have slid downwards from their original position. Clusters of elk teeth are often found in the area of the waist or pelvis (e.g. graves 13, 16, 106, 64, 114, 161 and 118).

## Brown bear teeth

The number of bear canines found in the graves under study ranges from zero to eight. Brown bear teeth have been found in the neck or chest area in eight graves (46, 64, 67, 86, 95, 114, 151 and 156), and they may be associated with necklaces or collar ornaments. Seven graves (25, 70, 95, 102, 113, 151, 157) contain one or several bear teeth on the waist, hips or upper leg area. These could be ornaments attached to belts or hanging from such belts. In ten graves, bear teeth are found in association with the skull (either above or by the left or right side of the deceased) (graves 4, 8, 56, 107, 111, 123, 138 and 161). Grave 138 contains a bear tooth on the deceased person's face, without any other artefacts.

## Eurasian beaver teeth

Beaver tooth plates have been documented in 47 graves, and their numbers in our sample of graves range from one to 125. They are located in the area of the head (5, 57), on the face (35, 56, 100, 115), neck (46, 86, 156), chest (5, 47, 70, 76a, 95, 114, 157), shoulders (119, 130, 191), waist or pelvis (13, 25, 38, 46, 47, 55, 69, 113, 114, 115, 134, 138), between or on the femora (35, 56, 57, 61, 68, 108, 127), and on the feet (109, 144).

The attachment method of the beaver teeth differs from the teeth of Eurasian elk and bear. The beaver tooth ornaments found at YOO cemetery are made by breaking the tooth in half lengthwise and using only the enamel part of the tooth. The enamel of a beaver's incisors is bright orange in colour, which makes them particularly beautiful (Fig. 1c). On the other hand, enamel breaks quite easily and thus may not be durable enough, for example, for use as a rattle. Therefore, we suggest that beaver teeth were attached tightly to the garments and did not hang free from them,

i.e. differing from the interpretation of the elk teeth. This interpretation is supported by the location of the grooves; most beaver tooth artefacts have grooves on both sides of the specimen. At YOO cemetery, beaver teeth were often found in clusters consisting of several specimens placed in rows (single teeth also appear in some of the graves).

### Animal teeth on the head and face

Several individuals have pendants around the head or on the face[1]. In grave 115, potentially that of a male, several beaver teeth were found arranged in a row on the face (the eye orbit), which can be interpreted either as headgear ornamentation or a mask. The individual in grave 35 (male) may have worn a mask containing beaver teeth. In some graves the teeth are on or even on top of the head (6, 85, 107, 111, 161), giving the impression of a different headdress. Of these, graves 85, 107, 111 and 161 have a pair of bear teeth.

### Animal teeth in the area of the neck

Pendants are located on the area of the neck in at least five burials (65, 67, 86, 114, 156; both males and females). In most cases, they form a compact, horizontal row or row-like formation in relation to the neck. These pendants may have been attached to a collar, or they may have been necklaces and not attached to fur or skin clothes at all. Most such sets combine elk and beaver teeth, and sometimes also bear teeth. Grave 65 is interesting because it contains 62 elk teeth in a cluster around the neck and no other tooth ornaments. Grave 156 contains elk and bear teeth and they are limited to the neck and shoulder area, while grave 86 contains elk and beaver teeth around the neck but no other pendants.

### Animal teeth on the upper body/shoulders and arms

Graves 1a, 4, 56, 96 and 107 are good examples of graves where clusters of pendants, mostly consisting of Eurasian elk teeth, are found almost symmetrically by the shoulders and arms of the deceased person. A logical explanation for this type of arrangement would be ornaments attached to the long sleeves of an item of clothing. N. N. Gurina (1956) mentioned that especially men found buried in the YOO cemetery wore elk teeth sewn on their sleeves and in the chest area, but we cannot confirm this interpretation as the biological sex of so many deceased persons remains unknown. Some graves (45, 76, 97) seem to have elk teeth on only one arm (instead of both), and in those cases, the decoration on the chest may have fallen off to one side, onto the arm. Such mid-chest beads are found in graves 50, 47 and 132. On the other hand, decorations on the torso extend to the thighs/knees in graves 61, 85 and 102, suggesting that they did not only serve as sleeve ornaments.

As already mentioned, we did not conduct a systematic analysis of the skeletal position or completeness of the human skeleton. However, we have made one observation of note: in several cases, the direction of the face (i.e. head is turned towards the left or right shoulder) and the teeth pendants are concentrated on the same side of the body (graves 61, 76, 85 and 102 and perhaps also 97). This potentially refers to a position where a cloth or wrap with tooth ornamentation has slid to one side, in the same direction toward which the head was tilted. In grave 85, all the Eurasian elk teeth are found on the left side of the body. Here, the face of the individual is bent towards the left, which might indicate that the whole body may have been tilted somewhat to the left, potentially resulting in the teeth pendants sliding into a new position. Thus, it is possible that the teeth were originally more evenly distributed over the body area.

Graves 46, 58, 61, 76a, 85, 92, 102, 113 and 157 contain a huge number of Eurasian elk teeth arranged from the upper torso to the legs and knees of the deceased. They seem to form a group of their own on a large, fully decorated garment. The graves almost always contain beaver and bear teeth as well (Fig. 3).

### Animal teeth at the waist

Teeth found at the waist of the deceased can derive from belts; they were either attached to the belt itself (in clusters) or hung from it. Tooth pendants are found in the waist area of the deceased in 18 graves[2]. Four of the deceased are males, one is potentially a male, five are females, one is potentially a female, and seven are of unknown biological sex. Graves 13, 25, 64, 69, 114, 127 and 161 contain elk and beaver teeth in the pelvic region, perhaps from a similar type of garment, possibly a belt, a waistband or the garment's hem. The decorations form a dense horizontal row running from the right to the left side of the body (Fig. 4).

The individual in grave 115 (the one furnished with a potential mask) seems to have been wearing a belt with elk and beaver teeth as ornaments and two bear teeth, perhaps hanging from it. An almost identical type of ornamented garment exists in graves 70, 113 and 157 (two females and one individual with unknown biological sex). In the latter case, elk tooth pendants are attached over a large area of the body, with beaver teeth in the area of the waist and bear teeth in the region of the pelvis and upper femora. The garment might have included a belt or a waistband ornamented with beaver tooth plates and suspended bear teeth.

### Animal teeth in the pelvic area and near the upper legs

In 23 graves, animal teeth are found in the pelvic area and on the upper legs[3]. Most often, teeth found in the pelvic area belong to the Eurasian elk or Eurasian beaver. Animal teeth found in the pelvic and upper leg area could be from orna-

1 E.g. graves 5, 6, 8, 35, 39, 56, 57, 67, 69, 81, 85, 107, 111, 115, 123, 138, 147, 153 and 161.

2 8, 21, 28, 39, 45, 47, 55, 58, 70, 95, 107, 109, 113, 114, 115, 129, 134 and 157.

3 Graves 13, 16, 25, 35, 46, 47, 57, 58, 64, 69, 76, 81, 106, 107, 111, 114, 115, 118, 127, 138, 147 and 161 potentially also 85.

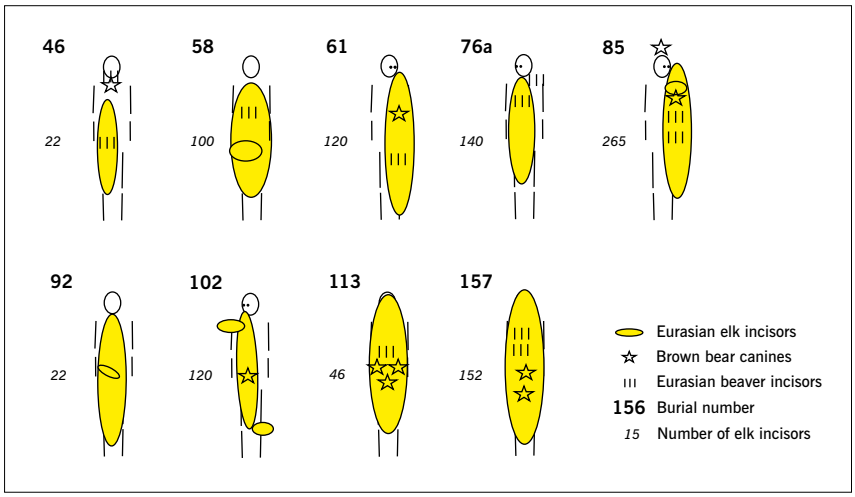


**Fig. 3** Some individuals at Yuzhniy Oleniy Ostrov, Republic of Karelia (Russia), have a fully decorated garment ornamented with Eurasian elk, brown bear and beaver teeth.

***Abb. 3*** *Einige Individuen in Yuzhniy Oleniy Ostrov, Republik Karelien (Russland), haben ein vollständig dekoriertes Gewand, das mit Zähnen von Elch, Braunbär und Biber verziert ist.*

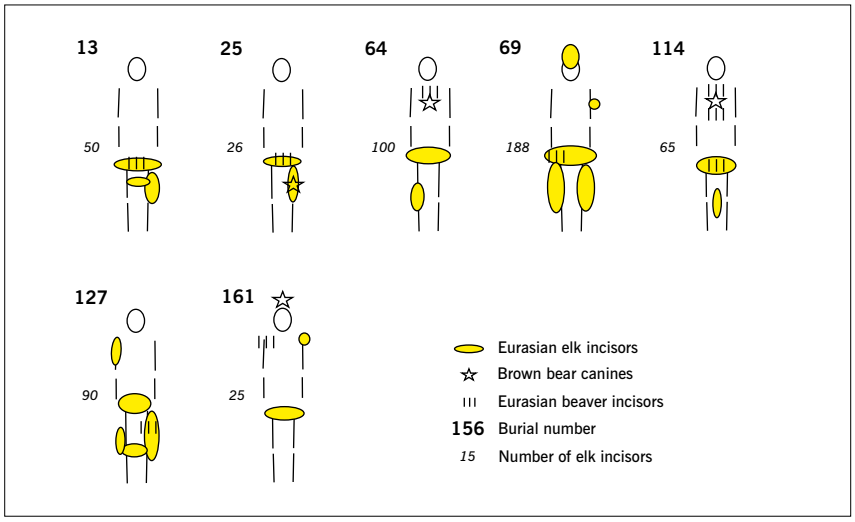


**Fig. 4** Similar garments could have been in several graves at Yuzhniy Oleniy Ostrov, Republic of Karelia (Russia). Individuals in these graves have Eurasian elk and Eurasian beaver teeth in the pelvic region. These decorations form a dense horizontal row running from the right to the left side of the body.

***Abb. 4*** *Ähnliche Kleidungsstücke könnten sich in mehreren Gräbern in Yuzhniy Oleniy Ostrov, Republik Karelien (Russland), befunden haben. Die Individuen in diesen Gräbern haben Zähne von eurasischem Elch und eurasischem Biber in der Beckenregion. Diese Verzierungen bilden eine dichte horizontale Reihe, die von der rechten zur linken Seite des Körpers verläuft.*

ments worn with tunic-type fur or skin clothing (or a dress, coat or apron). Clusters of pendants in the shape of a potential apron can be observed in graves 14, 57, 69, 95 and 127 (three females and two individuals with unknown sex). The decorations form not only horizontal but also vertical rows running parallel to the lower limbs of the deceased (Fig. 5).

## Animal teeth on the lower body, between the legs or knees and on the feet

Tooth pendants are found dispersed in the area of the lower body in several graves (e.g. 14, 57, 68, 69, 76, 125, 127 and 133). Sometimes, the clusters of elk teeth found on the upper legs are in well-defined vertical rows. Such is the case in graves 97 (135 teeth, some also lying on the right shoulder and arm), 69 (188 teeth), 57 (112 teeth), 127 (90 teeth, also on the waist and right arm) and 14 (33 teeth). Each of these graves contains a female individual, except one where the individual is of unknown sex. Such patterning may suggest that the teeth served as hem or apron ornamentation, but they might also have been used with leggings or long-legged footwear, especially when the ornaments are located in the immediate vicinity of the feet (Fig. 6). It is notable that footwear ornamentation is indicated in very few of the YOO burials, only in graves 57, 76, 97, 116, 124, 139 and 116 and perhaps 144 (half of these graves contain females and half males) (Fig. 7).

## Discussion

Despite the rather simplified approach, our analysis has made it possible to identify different types of clothing or accessories with which the deceased were equipped in YOO burial contexts. Some individuals have ornaments on the arms and hands (wrists), potentially indicating wristbands or long-sleeved coats or garments. Several individuals wore a long garment or coat with animal tooth ornamentation. Judging from the location of the pendants, similar types of clothing were worn by both males and females. Long-sleeved, lengthy garments ornamented with elk teeth seem to have been worn by both sexes. N. N. Gurina (1956) suggested that women, in particular, wore a garment or skirt adorned with elk incisors on the hem. It sometimes extended only to the hips, but in other cases the dress appears to have been longer, reaching down below the knees. We have outlined that the clothing of both sexes may potentially have been equipped with hem ornaments (of both elk and beaver teeth or of just one species).

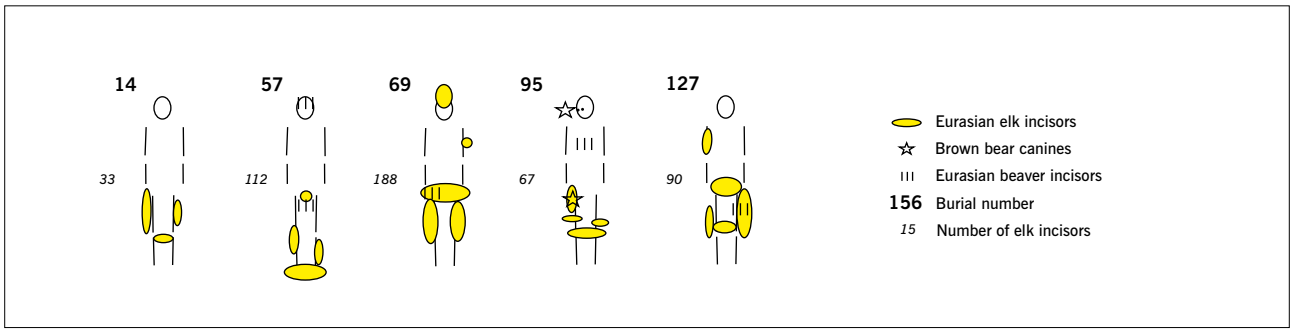


**Fig. 5** Several individuals have clusters of pendants in the shape of a potential apron. These decorations form not only horizontal but also vertical rows running parallel to the lower limbs.

***Abb. 5*** *Mehrere Individuen haben Gruppen von Anhängern in der Form einer möglichen Schürze. Diese Verzierungen bilden nicht nur horizontale, sondern auch vertikale Reihen, die parallel zu den unteren Gliedmaßen verlaufen.*

One difference between the sexes, however, is that vertical clusters of elk teeth by the legs of the deceased are found almost exclusively in the graves of females. They might have served as hem decorations or been worn in combination with leggings or footwear. Animal-skin footwear is known to have been used by several North Eurasian Indigenous populations. For example, leg skins from Eurasian elk and reindeer were traditionally used for footwear in eastern Lapland (Storå 1971, 213; Itkonen 1948, 323–326; Kirkinen et al. 2019) (Fig. 8).

Considering the high number of Eurasian elk teeth clusters found in some graves, it seems probable that such sets may have been used for sound-making purposes, perhaps as rattles (Rainio et al. 2021; see also Shaham/Belfer-Cohen 2017). When people move quickly, as when dancing, the hands and feet are the body parts most in motion, and it is easy to control the rhythm of the rattles with one's hands and feet. In that sense, such richly ornamented outfits could be considered similar to instruments that were primarily used on special occasions. A costume with approximately 300 Eurasian elk teeth (such as found in graves 85, 100 and 107) would be heavy, uncomfortable and impractical, making it unlikely that such clothes were worn in everyday life or when hunting. The possibility should be considered that those individuals found with a high number of pendants were buried in their festive outfits.

Some graves at the YOO cemetery contain several pendants on the head of the deceased; this probably indicates some type of headgear, such as a hat, hood, or even a crown-like head covering as is often linked with a distinct social status (as a shaman, for example)[4]. Indications of headgear are found in both female and male graves. It is quite difficult to estimate the type of headgear just by considering the locations of the tooth pendants. Most likely, all Mesolithic people living in the Onega region used headgear such as a hat or hood, at least during the winter when it was too cold to be bare-headed outdoors (Fig. 9). However, perhaps only shamans or other leaders used richly ornamented headgear.

It can be difficult to distinguish between a headdress and a mask if judging just by the pendants' location. Grave 115 can be interpreted as containing a mask since the beaver teeth lay on the glabellar area and orbits, showing that the eyes might indeed have been covered (Fig. 10). Possible masks with tooth pendants have also been found in other Mesolithic cemeteries, for example in a male burial in Donkalnis, Telšiai County (Lithuania; Butrimas 2012). In the existing ethnographic literature, the mask has been interpreted as a medium for transforming or changing a person's identity (see Pizzorno 2010); it has likewise been suggested that masks were worn for such purposes in prehistoric contexts (Mannermaa 2025). E. A. Kashina et al. (2020) have suggested similar intentions related to the tradition of burying the dead in a prone position, as observed in some hunter-gatherer cemeteries: the purpose may have been to hide the eyes of the deceased, as can be done by using masks. One reason for covering the eyes with a mask could relate to a belief known from studies of Indigenous cultures in the Altai area in Mongolia, according to which the soul was in an individual's eyes (Harva 1933, 175). Shamans commonly wore masks to hide their souls from the spirits they encountered, and the eyes or the face of the deceased were also covered, for example with fish skin or textiles (Harva 1933, 192–193).

We suggest that belts were an important part of Mesolithic clothing for everybody, including all age groups. Some researchers argue that belts are more commonly found in female burials than male burials. For example, N. N. Gurina (1956, 186) observed that in several graves, especially those of females, elk incisors were concentrated around the pelvic area. Scholars have made the same observation at Skateholm I and II, Skåne County (Sweden), where ornamented bands around the hips have been found particularly in female graves (Larsson 2024). However, our analysis, using updated data on biological sex, does not definitively support this argument. Although belts for women and men could have differed in appearance, our data reveal that elk and beaver tooth ornaments may well have been used on belts or waistbands by

4 Holmberg 1922, 15–17; Zagorska/Lõugas 2000; Butrimas 2016; Mannermaa/Kirkinen 2020.

**Fig. 6** Skolt Sámi (eastern Sámi) men wear ›leg-pants‹ (Fin. *koipihousut*), over their pants and fur-lined shoes on their winter trips. The garment consists of overshoes, an upper part made of untanned reindeer *(Rangifer tarandus)* hide (made from the legs of six reindeer) and a pair of tanned reindeer hide pieces, which are fastened at the hips with a cord (nowadays also with buttons) Reindeer skin and fur. Length 91 cm.

***Abb. 6*** *Die Männer der Skolt Sámi (Ostsámi) tragen auf ihren Winterausflügen ›Beinkleider‹ (Finn.* koipihousut*) über ihren Hosen und pelzgefütterten Schuhen. Das Kleidungsstück besteht aus Überschuhen, einem Oberteil aus ungegerbtem Rentierfell* (Rangifer tarandus) *(hergestellt aus den Beinen von sechs Rentieren) und einem Paar gegerbter Rentierfellstücke, die an der Hüfte mit einer Kordel (heute auch mit Knöpfen) befestigt werden. Rentierhaut und Fell. Länge 91 cm.*

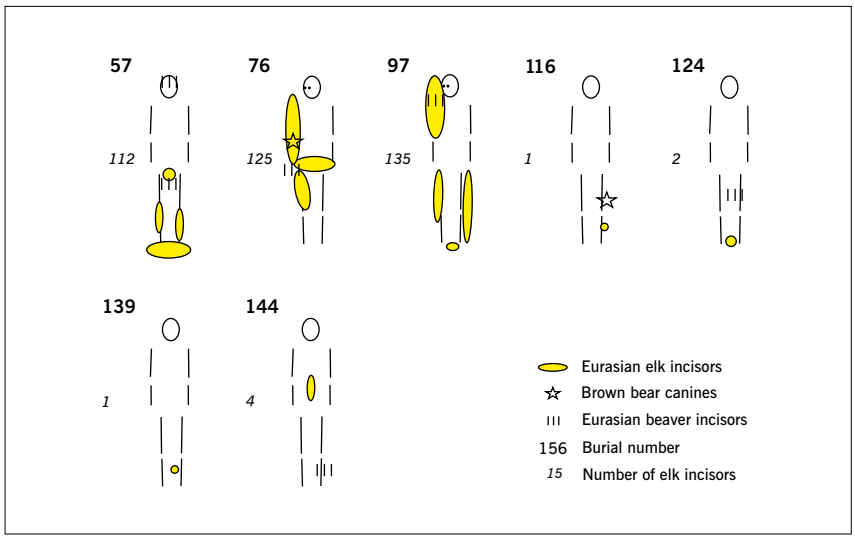


**Fig. 7** The location of the ornaments in the immediate vicinity of the feet may indicate the presence of footwear.

***Abb. 7*** *Die Lage der Ornamente in unmittelbarer Nähe der Füße könnte auf das Vorhandensein von Schuhen hinweisen.*

**Fig. 8** Screenshot from a video showing a hypothetical reconstruction of tooth pendants sewn onto an apron and rattling against each other. The reconstruction, inspired by YOO's graves, features 94 Eurasian elk incisors.

***Abb. 8*** *Screenshot aus einem Video, das eine hypothetische Rekonstruktion von Zahnanhängern zeigt, die auf eine Schürze genäht sind und gegeneinander klappern. Die Rekonstruktion, die von YOOs Gräbern inspiriert wurde, enthält 94 Elchschneidezähne.*

both sexes. While indications of belts are not found in all the graves with animal teeth in the YOO cemetery, it is possible that everyone was buried with a belt, but some were made solely of soft, perishable materials that have not been preserved. Soft materials, like feathers, down or different types of furs or skins (and other body parts) can be used for decoration instead of teeth, and bird skins may have been used for insulation (see Kirkinen in this volume), as indicated by the microscopic find of a potential bird barbule in soil samples from grave 29 at YOO cemetery (Mannermaa/Kirkinen 2020).

In addition to being an important functional clothing item, belts have carried other meanings as well. For historical populations of Russia, belts were loaded with symbolic, religious and protective meanings (Bayburin 1992; Ermolova 2005). Male Sámi reindeer herders in northern Finland had several different skin belts, some of which were ornamented and used only on special occasions (Itkonen 1948, 362–363). Belts were also a significant part of a shaman's costume. Among the Nenets of northern Siberia, artefacts like bear teeth and bird claws have been found hanging on shamanic belts; they helped the shaman reach other worlds (Hoppál 2001, 84).

## Clothing culture

Ethnographic studies have revealed that animal skins and furs were traditionally used for making clothes (e.g. Itkonen 1948). In some graves at the YOO cemetery, skin and fur manufacturing are indicated by tools associated with skin craft, such as awls for piercing and polishers for skin softening. Based on a study of all the graves containing elk teeth, we can conclude that the ornament culture has been relatively similar among the group(s) using the YOO cemetery, as indicated by the rather restricted materials used in ornamentation, i.e. particular teeth from Eurasian elk, bear and Eurasian beaver. Animal teeth were clearly an important part of the clothing culture in Mesolithic Karelia, but we did not detect any single dominant style in the use of pendants. At Skateholm, animal teeth were found mainly in the pelvic region (Larsson 2024). In Saktysh cemetery, Ivanovo Oblast (Russia; Lyalovo and Volosovo Cultures), animal teeth have mainly been found in the pelvic region and by the legs, while at Zvejnieki, Valmiera Municipality (Latvia), they have been found by the head and on the torso (Macāne 2022, 307).

**Fig. 9a–b** a Ostyak (Siberia) man's fur coat. It is made of light brown and white reindeer fur. The hood is made of light, thick reindeer fur. The cuffs have a red border 10 cm wide. b The seams on the back of the fur coat are decorated with red and dark blue textile stripes.

***Abb. 9a–b*** *a Pelzmantel eines Ostyak (Sibirien) Mannes. Er ist aus hellbraunem und weißem Rentierfell gefertigt. Die Kapuze besteht aus hellem, dickem Rentierfell. Die Manschetten haben eine 10 cm breite rote Borte. b Die Nähte auf der Rückseite des Pelzmantels sind mit roten und dunkelblauen Textilstreifen verziert.*

Based on ethnographic evidence, we know that specialised winter and summer garments were used in northern Europe (Itkonen 1948). However, our own relatively general analysis could not determine whether people were customarily buried in their winter, summer, daily or ceremonial clothes.

Although this paper approaches animal teeth as ornaments on clothing, other accessories, such as bags, skin or fur containers, blankets, and wrappings may also have been decorated (e.g. Rainio/Tamboer 2018). For example, N. N. Gurina (1956, 193–195) identified eight graves that probably contained quivers made of some organic material based on clusters of arrowheads. In some Stone Age hunter-gatherer burials at Zvejnieki, animal tooth pendants were found outside the area of the body, indicating that they were also used with garments that cannot be directly associated with the clothes of the deceased (Macāne 2022, 307).

Richly ornamented headgear or masks may indicate that the deceased occupied an important social or spiritual role in the community. Sometimes, the number of tooth pendants in a grave has also been interpreted as an indication of spiritual leadership, i.e. that the deceased was a shaman. Caution must be taken, though, when basing conclusions about a population´s social identities on preserved material culture; such objects probably represent only a fraction of the materials the original grave contained. Just like animal teeth, paws, feathers, skins and other soft materials from various animals may have been important symbols or markers of social or kin identity (Mannermaa et al. 2021). Such materials are usually invisible in archaeological contexts because they do not preserve as well as bone, antler and tooth.

## Conclusions

From the personal ornaments found in the graves, it is possible to deduce patterns of clothing and accessories. In this preliminary study, we have shown that in the YOO cemetery, both women and men wore various types of clothing decorated with animal teeth. Belts appear in both female and male graves, as does headgear. The latter can be hoods, hats, or more elaborate constructions resembling ceremonial headdresses. Hem ornaments and various vertical decorations on the legs are found in many graves. There are indications of

**Fig. 10** Grave 115 in Yuzhniy Oleniy Ostrov, Republic of Karelia (Russia), cemetery contained Eurasian beaver *(Castor fiber)* incisor plates on the frontal bone and eyebrows.

***Abb. 10*** *Grab 115 im Gräberfeld von Yuzhniy Oleniy Ostrov, Republik Karelien (Russland), enthielt Schneidezahnplatten des Eurasischen Bibers* (Castor fiber) *am Stirnbein und an den Augenbrauen.*

possible leggings, especially in women's graves. The way the tooth pendants are made suggests that the teeth of Eurasian elk and bears were suspended, while beaver teeth were more firmly attached to garments. The clothing culture that we reconstruct here, based on the animal teeth in the graves, seems more like ceremonial clothing than everyday garb.

## Acknowledgements

The National Museum of Finland (Helsinki), The Sámi Museum Siida (Inari) and The Peter the Great Museum of Anthropology and Ethnography, Kunstkamera (St. Petersburg) are thanked for permissions for photos, and PhD researcher Olga Batanina (University of Helsinki) for sharing her unpublished research data. This research is financed by the ›Animals Make Identities. The Social Bioarchaeology of Late Mesolithic and Early Neolithic Cemeteries in North-East Europe (AMI)‹ project, which has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 864358). In addtion, the research has been funded by the Academy of Finland (Grant number 1315164).

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# Schnurkeramische Taschen im Saale-Unstrut-Gebiet – eine lokale Handwerkstradition mit hohem Symbolgehalt

Susanne Friederich, Carola Oelschlägel und Björn Schlenker

**Summary**

Corded Ware bags in the Saale-Unstrut region – a local craft tradition with great symbolic significance

*During the Corded Ware culture, in the region between the Unstrut and Weiße Elster rivers and extending to the Sangerhäuser Mulde and the lower Saale valley, elaborately decorated bags were a regular constituent of the traditional attire of young adult women, who probably belonged to an elite social class. The bottom of the pouch-shaped object is usually 30 cm long; the bags were probably 20 cm high. They were worn on a broad strap that, like the entire front surface of the bags, was decorated with animal teeth – perforated incisors and canines from dogs – sewn on in a staggered pattern resembling roof tiles. Young dogs of a medium sized breed were systematically killed and their front teeth deliberately removed for this purpose.*

*The pouch-shaped bags are, as indicated by the occasional infant bones found inside them, a type of baby carrier. The baby's legs, arms, and head protruded and were additionally protected with a fine fabric; the 20 cm wide cloth was embroidered with paillettes and trimmed with dog molars. The position of the carrying pouch in the grave may indicate whether the wearer died during pregnancy or at a later stage. Apparently, these bags were personal accoutrements that could not be passed on.*

**Keywords** Late Neolithic, burials, animal teeth, carrying pouches, grave goods

**Zusammenfassung**

*Während der schnurkeramischen Kultur sind im Raum zwischen den Flüssen Unstrut und Weißer Elster mit Ausläufern bis an die Sangerhäuser Mulde und das Untere Saaletal aufwendig verzierte Taschen ein regelmäßiger Bestandteil der Tracht junger erwachsener Frauen, die einer elitären Gesellschaftsschicht angehört haben dürften. Der Boden der beutelförmigen Objekte ist in der Regel 30 cm lang; die Höhe der Taschen betrug wahrscheinlich 20 cm. Getragen wurden sie an einem breiten Gurtband, das wie die gesamte Frontfläche der Taschen mit dachziegelartig gestaffelt aufgenähten Tierzähnen – durchlochte Incisivi und Canini von Hunden – bestickt war. Für ihre Herstellung wurden junge Hunde einer mittelgroßen Rasse planmäßig getötet und ihre Frontzähne gezielt entnommen.*

*Die beutelförmigen Taschen sind, wie vereinzelt darin erhaltene Säuglingsknochen anzeigen, eine Art Babytrage. Beinchen, Ärmchen und der Kopf ragten heraus und wurden mit einem feinen Tuch zusätzlich geschützt; der 20 cm breite Schal war mit Pailletten bestickt und mit Molaren von Hunden gesäumt. Anhand der Positionierung der Tragebeutel im Grab lässt sich ablesen, ob die Trägerinnen bereits während der Schwangerschaft oder zu einem späteren Zeitpunkt verstorben waren. Es handelt sich bei den Taschen um eine persönliche, nicht vererbbare Ausstattung.*

**Schlagwörter** Spätneolithikum, Bestattungen, Tierzähne, Tragetaschen, Grabbeigaben

Die schnurkeramische Kultur ist vom Elsass bis zur Ukraine und von Südskandinavien bis zu den Alpen hin verbreitet (2825–2200 v. Chr.). Unmittelbare Siedlungshinweise wie Hausgrundrisse, Ofenanlagen oder Brunnen sind trotz großflächiger Ausgrabungsprojekte der letzten 25 Jahre (Friederich 2019; Stäuble/Friederich 2019; Balfanz u. a. 2019) noch immer recht dürftig.

Gräber – meist kleinere Bestattungsgruppen, seltener ausgedehnte Friedhöfe – sind aus allen Fundprovinzen in großer Zahl bekannt. Über Tausende von Kilometern hinweg ist der schnurkeramische Bestattungsritus streng normiert. In aller Regel pflegte man die Sitte der Einzelbestattung, bei welcher der Leichnam in hockender Stellung mit Blick nach Süden in der Grabstelle zu liegen kam. Meist achtete man bei der Ausrichtung der Toten darauf, dass die Männer auf der rechten Seite ruhend und die Frauen in linksseitiger Lage beigesetzt wurden. Auch bei der Ausstattung zeichnen sich überregional verbindliche Sitten ab. Neben den aus Keramik gefertigten Gefäßen, zumeist Becher und Amphoren, die sich bei beiden Geschlechtern finden, gilt vor allem die Steinaxt als männliche Insignie, während Schmuck- und Trachtbestandteile beim weiblichen Ausstattungskanon im Vordergrund stehen. Diese sind insbesondere aus Knochen, Geweih, Muscheln oder gelegentlich Bernsteinen gefertigt. Häufig wurden zudem aus Perlmutt hergestellte Pailletten, resp. durchlochte Muschelscheibchen und gelegentlich Perlen aus den steinharten Früchten des Steinsamen *(Lithospermum officinale)*, einer krautigen Pflanze, bekannt.

Vor allem im mitteldeutschen Raum, aber auch in Böhmen (Kyselý u. a. 2019; Kyselý 2021) dominieren zudem apikal durchbohrte Zähne, meist von Hunden. Entsprechend der jeweiligen Objektlage im Grab zeigen diese längst ver-

**Abb. 1** Profen, Burgenlandkreis, Bef. 7618. Sog. Kettenhocker der schnurkeramischen Kultur. Die linear entlang der Grabgrube aufgereihten durchlochten Tierzähne (Pfeile: Eckzähne von Hunden) deuten eine aufwendig gesäumte Decke an.

***Fig. 1*** *Profen, Burgenlandkreis District, feature 7618. So-called Kettenhocker (crouched burial) of the Corded Ware culture. The rows of perforated animal teeth (arrows: canine teeth of dogs) lined up in the burial pit are indicative of an elaborately edged covering.*

**Abb. 2** Profen, Bef. 7868. Sog. Kettenhocker der schnurkeramischen Kultur. Der lineare Verlauf der aufgereihten Tierzähne im Lenden- bzw. Kniebereich weist beispielsweise auf einen Mantelbesatz hin.

***Fig. 2*** *Profen, feature 7868. So-called Kettenhocker (crouched burial) of the Corded Ware culture. The linear arrangement of the rows of animal teeth in the lumbar and knee area suggests, for example, the trim on a cloak.*

**Abb. 3** Profen, Bef. 5117. Durchlochte Molaren von Hunden bilden häufig den Abschluss eines mit Pailletten aufwendig verzierten Stoffes.

***Fig. 3*** *Profen, feature 5117. The perforated molars of dogs often form the border of a cloth elaborately decorated with paillettes.*

gangene organische Materialien, Textil oder Leder, an: am Rand gebördelte Decken, bestickte Tücher, Gürtelgehänge, Mantelbesätze, bestickte Hauben, Armbänder und vieles mehr (Abb. 1–2). Die lineare Aufreihung der Zähne erklärt auch die Bezeichnung ›Kettenhocker‹[1] des vom Thüringer Becken (Fischer 1956) bis in die Magdeburger Börde[2] verbreiteten Gräbertyps[3]. Gelegentlich zieren auch durchlochte Backenzähne Stoffe oder vergleichbare Materialien (Abb. 3). Dabei könnte es sich um die Einfassungen von Tüchern handeln, die mit Muschelpailletten überzogen waren, wie es Grab 2110 aus Wennungen, Burgenlandkreis, nahelegt (vgl. Abb. 7). Die kleine Anzahl entsprechender Befunde erlaubt es nicht, eine Regelhaftigkeit abzuleiten. Zahnschmuck kommt vereinzelt auch bei männlichen Bestatteten, gehäuft bei der gemeinsamen Niederlegung mit einem Kind, vor[4]. Zwischen Unstrut und Weißer Elster mit Ausläufern bis an die Sangerhäuser Mulde und das Untere Saaletal (Abb. 4) wurden, wie fast 20 Frauenbestattungen belegen, durchlochte Hundezähne sogar flächendeckend aufgenäht (Tab. 1).

Bei den Zähnen handelt es sich hauptsächlich um die Eckzähne sowie die zweiten und dritten oberen Schneidezähne; die Wurzeln der ersten Incisivi sind für die Durchlochung zu klein. Die verwendeten Zähne wurden übereinander gestaffelt aufgenäht. Dabei wurden diese streng nach anatomischen Grundsätzen bzw. nach ihrer Größe positioniert. Die größten Zähne, also die Eckzähne, bilden die unteren Reihen, daran schließen sich darüber in gleicher Anordnung die dritten Schneidezähne an; am oberen Rand endet die Verzierung dann mit den kleinsten verwendeten Zähnen: den Schneidezähnen und gelegentlich auch kleinen Backenzähnen. Bis zu zehn übereinanderliegende Reihen sind dokumentiert. Gelegentlich ist dazwischen ein aus Bernsteinperlen aufgebautes Band eingefügt (Abb. 5).

Bei diesen Objekten handelt es sich zweifellos um Taschen[5], deren organisches Material längst vergangen ist;

1 Vgl. zur Begrifflichkeit die Nennung bei Möller 1912, 105–107.

2 Z.B. Förderstedt, Salzlandkreis (Akt.-Nr. 14047).

3 Durchlochte Tierzähne oder Hirschgrandeln, aufgereiht zu Ketten, sind seit dem frühen Neolithikum bekannt (vgl. Bogen/Pichler 2012; Bogen/Döhle 2012). Vor allem während des Mittelneolithikums kommt durchlochten (Hunde-)Zähnen eine große Rolle zu – teilweise als Halsketten getragen, teilweise als Verschlusselement von Beuteln (Friederich 2020). Auch aus der Glockenbecherkultur sind solche im mitteldeutschen Raum bekannt (z. B. Wedringen, Lkr. Börde [Akt.-Nr. 15960]).

4 W. Matthias (1969, 13–14) verweist im Zuge seiner umfangreichen Grundlagenarbeiten darauf, dass sich Hundezähne und Waffen bei den einzelnen Grablegen ausschlössen – Tierzahnschmuck also zur Ausstattung der Frauen gehöre. Aus dem Tagebau Profen liegt eine Doppelbestattung (Mann und Kind) mit drei durchlochten Tierzähnen vor (Akt.-Nr. 2510, Bef. 7188; unpubl.). Es ist davon auszugehen, dass die Tierzähne zur Beigabe des Kindes zählen. M. Hein (1987, 134) zeigt auf, dass Dreiviertel der hundezahnführenden Beigesetzten weiblich sind.

5 Taschen aus längst vergangenem Material dürften Menschen seit jeher gefertigt haben, wenngleich Nachweise selten möglich sind. Exakt nebeneinanderliegende Werkzeuge wie beispielsweise beim linienbandkeramischen Dechseldepot von Profen, Burgenlandkreis (Friederich u. a. 2022), oder die Fundposition im schnurkeramischen Doppelgrab von Gaimersheim, Lkr. Eichstätt (Weiner 2013, 25), belegen eine organische Umfassungshülle.

| Fundplatz | Befund | Hauptbestattung | | bestattet mit | absolutchron. Datierung | Tasche | | | | Tuch | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (weiblich) | Sterbezeitpkt. Schwanger-schaft | | kalibriert (cal BC) (95 %) | erhaltene Fläche Breite (cm) | Höhe (cm) | Verhältnis | Gurtband | »Paillette« | »Backenzahn« | Position |
| Friedrichsschwerz | 180 | spätadult/ frühmatur | | spätadult/ frühmatur | | 21,0 | 17,8 | (1/1) | | x | x | Bernstein, Kuperblättchen |
| Karsdorf | 59 | erwachsen | | infans | 2820–2662 | n. b. | n. b. | n. b. | x | x | x | Tuch über Oberkörper und Tasche geführt |
| Oechlitz | 15109 | adult | x | | 2573–2472 | 30,5 | 15,3 | 2/1 | | | | |
| | 25334 | adult | (x) | inf. I; inf. II | 2574–2466 | 23,9 | 9,2 | 5/2 | x | | | ggf. Kind in Tasche |
| | 25496 | subadult | | infans II | | 20,3 | 13,6 | 3/2 | x | x | | |
| | 25570 | spätadult/ frühmatur | | | | 22,8 | 15,8 | 3/2 | x | x | | Tuch von Schulter bis Kniebereich geführt |
| | 26615 | spätadult/ frühmatur | x | | | 27,5 | 18,3 | 3/2 | | x | | Tuch über Lendenbereich ggf. bis zur Tasche geführt |
| | 25815 | adult | | | 2617–2473 | 32,1 | 15,1 | 2/1 | | x | | Tuch bedeckt Tasche |
| | 20020 | juvenil-matur | | | 2617–2472 | 31,9 | 21,3 | 3/2 | x | x | | |
| | 21827 | matur | | inf. I–II | | 15,0 | 10,0 | 3/2 | x | | | |
| Profen | 5117 | spätadult/ frühmatur | x | | | 24,0 | 20,0 | 5/4 | | | x | Tuch über Lendenbereich ggf. bis zur Tasche geführt |
| | 5307 | spätadult/ frühmatur | | | | n. b. | n. b. | | x | | | |
| | 7844 | spätadult/ frühmatur | | | | n. b. | n. b. | | | | | |
| | 7868 | spätadult/ frühmatur | | | | n. b. | n. b. | | | | | |
| | 8118 | spätadult/ frühmatur | | | | 36,0 | 18,0 | 2/1 | | x | x | Tuch über Schädel der Frau und ggf. über Tasche |
| Rothenschirmbach | 1002 | spätadult/ frühmatur | x | | | n. b. | n. b. | | | x | x | |
| Wennungen | 1003 | n.n. b. | (x) | | | | | | (x) | x | x | Tuch überdeckt ggf. Tasche |
| | 2110 | matur | | neonatus | | 26,0 | 14,5 | 3/2 | | x | x | Kind in Tasche, mit Tuch bedeckt |
| | 5036 | matur | | neonatus | | | | | | | | |
| Helbra | 33 | erwachsen | | | | 17,0 | 20,0 | 4/5 | x | | | |

**Tab. 1** Schnurkeramische Bestattungen mit Taschenbeigabe unter Berücksichtigung von ergänzenden Tüchern (n. b. nicht bestimmbar; n. n. b. noch nicht bestimmt).

***Tab. 1*** *Corded Ware burials with bags, taking into account additional fabrics (n. b. undeterminable; n. n. b. not yet determined).*

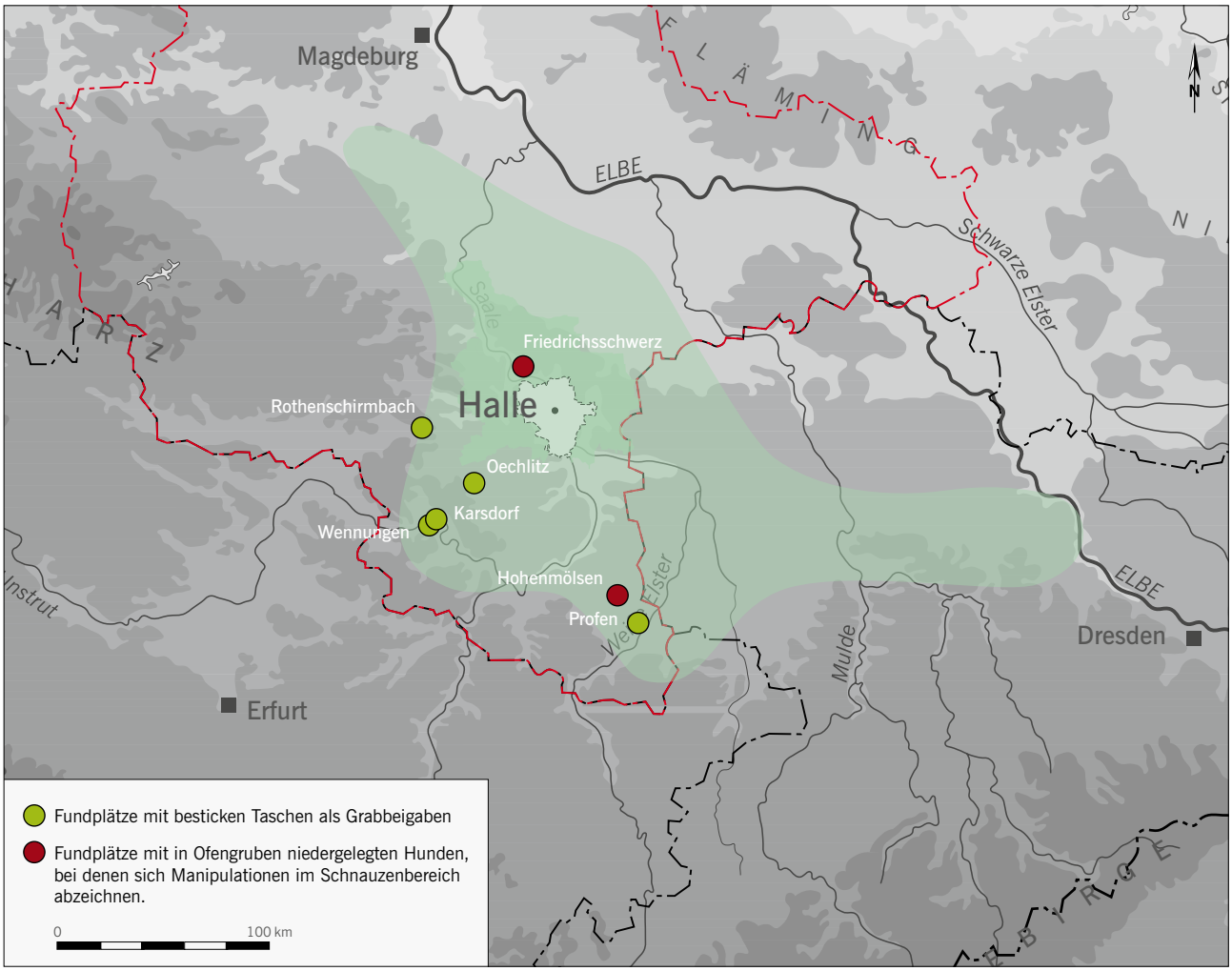



**Abb. 4** Verbreitung der zweikammerigen Ofengruben (grüne Fläche) unter besonderer Berücksichtigung von Fundplätzen mit bestickten Taschen bzw. manipulierten Hundeschnauzen.

***Fig. 4*** *Distribution of two-chambered kiln pits (green area) with special consideration given to sites where decorated bags or manipulated muzzle sections of dogs have been found.*

**Abb. 5** Profen, Bef. 5117. Bernsteinperlen (rot eingekreist) geben wie Muschelpailletten Hinweise auf längst vergangene organische Materialien, die in Mineralböden nur über organische Hartmaterialien ausschnitthaft erhalten sind.

***Fig. 5*** *Profen, feature 5117. Amber beads (circled in red), like shell sequins, provide evidence of long-gone organic materials that are preserved in mineral soils only in partial form via organic hard materials.*

**Abb. 6** Profen, Bef. 8118. Vor der Brust der Toten befindet sich eine über aufgestickte organische Hartmaterialien – hier durchlochte Hundezähne – erhaltene Tasche. Auch der Ansatz der beiden Gurtbänder an der Tasche lässt sich anhand der durchlochten Eckzähne erkennen (s. Abb. 45).

***Fig. 6*** *Profen, feature 8118. Before the dead woman's chest is a bag evidenced by sewnon organic hard materials – in this case perforated dog teeth. The two straps attached to the bag can also be recognised by means of the perforated canines (see Fig. 45).*

nur die applizierten Zähne blieben erhalten (Abb. 6–10)[6]. Getragen wurden die beutelförmigen Taschen an einem breiten Gurtband (Abb. 11–12). Dieses zeichnet sich gleichfalls anhand von aufgestickten Zähnen – vornehmlich oberen und unteren Eckzähnen – ab. Der Taschenboden war meist ca. 30 cm lang. Der obere Randabschluss der Beutel fehlt fast immer. Die Höhe lässt sich nur als Mindestmaß mit 20 cm angeben. Die Öffnung könnte aus vergänglichem Material beschaffen gewesen sein. Bei vollbestickten Taschen wurden fast 350 Zähne benötigt; in einem Fall lassen sich knapp 60 ›verarbeitete‹ Hundeindividuen rekonstruieren: Wennungen, Bef. 2110 (s. Abb. 7–8). In Ausnahmefällen wurde mit einem Fuchszahn bzw. einem aus Knochen geschnitzten Zahnimitat[7] ausgeholfen, was sicherlich auf Reparaturmaßnahmen zurückzuführen ist. Seltener fanden auch die Zähne anderer Tierarten wie Dachs, Wildkatze, Wildschwein, Schaf bzw. Ziege oder gar Fischotter wie auch Hirschgrandeln Verwendung (Petzold 2003). Ganz besonders wertig waren sicherlich Taschen, bei denen zusätzlich Bernsteinperlen aufgenäht worden waren.

Beispielhaft zeigt Bef. 8118 aus dem Tagebaugebiet Profen, Burgenlandkreis (s. Abb. 6; s. u. Abb. 45), den Aufbau solcher Taschen bzw. deren Vorderseite oder Überschlag. Die unterste Reihe bilden 56 obere und untere Eckzähne, davon 13 am Gurtband. In der darüber liegenden Reihe sind die Zähne kleiner; es handelt sich um 31 Exemplare der dritten oberen Schneidezähne und elf Eckzähne (nicht in Ausrichtung dieser zweiten Reihe, evtl. verlagert). Ungefähr

6 Bereits Anfang der 1950er-Jahre stellte H.-D. Kahlke ausgehend von der Dreifachbestattung von Gotha-Siebleben, Seeburg (zwei Erwachsene, ein Kind), die Überlegung an, ob durchlochte Tierzähne aus schurkeramischen Bestattungen ggf. nicht nur Decken, sondern auch Kleidungsstücke oder gar Taschen anzeigen könnten (Kahlke 1953/54, 172). Gleiches könnte zudem aus der Umzeichnung eines Grabungsfotos der weiblichen Bestattung aus Hardisleben, Bachsteinsche Kiesgrube, Lkr. Sömmerda, gelten (Kahlke 1953/54, Abb. 7) sowie gemäß Beschreibung für eine Bestattung nahe Vieselbach bei Erfurt, Hasenberg (Kahlke 1953/54, 162–163).

7 Flache, an den Kanten abgerundete Knochenplatten.

**Abb. 7** Wennungen, Burgenlandkreis, Bef. 2110. Die rechte Hand der Toten ruht auf der mit Tierzähnen bestickten Tasche bzw. auf dem Kopf des darin getragenen Säuglings (s. Abb. 8; 13–14; 49).

***Fig. 7*** *Wennungen, Burgenlandkreis District, feature 2110. The dead woman's right hand rests on the bag decorated with animal teeth or rather on the head of the infant carried in it (see Fig. 8; 13–14; 49).*

**Abb. 8** Wennungen, Bef. 2110. Detailaufnahme der Tasche. Teilweise ist diese mit einem feinen Stoff bedeckt, angezeigt über die dicht an dicht aufgestickten Muschelpailletten. Möglicherweise überdeckte das Tuch das in der Tasche getragene Kind (s. Abb. 7; 13–14; 49).

***Fig. 8*** *Wennungen, feature 2110. Closeup of the bag. It is partially covered with a fine cloth, indicated by the densely embroidered shell sequins. It is possible that the material covered the child carried in the bag (see Fig. 7; 13–14; 49).*

**Abb. 9** Profen, Bef. 5117. Detailaufnahme der ersten erkannten Taschenbeigabe in einem schnurkeramischen Grab. Das Objekt wurde als Teilblock geborgen.

***Fig. 9*** *Profen, feature 5117. Close up of the first recognised bag in a Corded Ware grave. The object was recovered as a partial block.*

**Abb. 10** Helbra, Lkr. Mansfeld-Südharz, Bef. 33. Eine mit zahlreichen Tierzähnen applizierte Tasche lag vor der Brust einer Frau. Das Objekt wurde als Teilblock geborgen.

***Fig. 10*** *Helbra, Mansfeld-Südharz District, feature 33. A bag decorated with numerous animal teeth lay in front of a woman's breast. The object was recovered as a partial block.*

30 obere dritte Schneidezähne bilden die darüber liegende Reihe, darüber folgen ca. 40 obere dritte Schneidezähne. Die drei oberen Reihen umfassen jeweils mindestens 30 der zweiten Schneidezähne. Das zum Kopf hinweisende Gurtband bzw. das Trageband setzt im unteren Bereich der Tasche bzw. an ihrem Boden an und besteht aus zwei Reihen von Eckzähnen. Demnach ist nur der unmittelbare Trägeransatz mit einer Doppelreihe von elf bzw. 13 Eckzähnen verziert. Für die entgegengesetzte Seite wurden für die doppelzeilige Verzierung ca. 40 Eckzähne verwendet.

Meist handelt es sich bei den mit Taschen ausgestatteten Individuen um adulte Frauen. In einigen Fällen wurde ein Kind mit im Grab beigesetzt – bei der Bestattung von Wennungen sogar in einem aufwendig bestickten Beutel (s. Abb. 7). Der Kopf des Neugeborenen lag auf Höhe der mütterlichen Brust, die Langknochen an der gegenüberliegenden Beutelkante (Abb. 13–14). Auch bei anderen Bestattungen zeigt sich, dass der Beutel so vor dem angewinkelten linken Arm lag, dass ein Umfassen der Tasche mit der rechten Hand möglich war (Abb. 15) – es dürfte sich also um eine Art Babytrage gehandelt haben, wie sie noch heute vielfach gebräuchlich ist. Hatte man demnach beim zeitgleichen Tod von Mutter und Säugling beide samt Tragebeutel bestattet?

In Wennungen könnte der gemeinsame Tod während des Wochenbettes oder im Laufe der ersten Lebensmonate eingetreten sein. Für die Bestattung Friedrichsschwerz (Bef. 180, Abb. 16; s. u. Abb. 21) und die Bestattung 21827 aus Oechlitz (s. u. Abb. 39), beide Saalekreis, ist ein späterer Zeitpunkt anzunehmen. Dass die mit Hundezähnen verzierten Prachtstücke vielleicht schon zu Beginn des fortpflanzungs-

**Abb. 11** Profen, Bef. 5307. Die doppelte kurvolineare Reihung der durchlochten Hundecanini bildet den Ansatz eines mit Tierzähnen verzierten bzw. verstärkten Gurtbandes einer Tasche.

***Fig. 11*** *Profen, feature 5307. The double curvilinear row of perforated dog canines forms the base of a decorated or reinforced strap of a bag.*

**Abb. 12** Wennungen/Wetzendorf, Saalekreis, Bef. 1003. Die eng miteinander verzahnte, aus durchlochten Hundecanini aufgebaute Doppelreihe gilt als Indiz für das Gurtband einer Tasche.

***Fig. 12*** *Wennungen/Wetzendorf, Saalekreis District, feature 1003. The closely interlocked double row of perforated dog canines is regarded as evidence for the strap of a bag.*

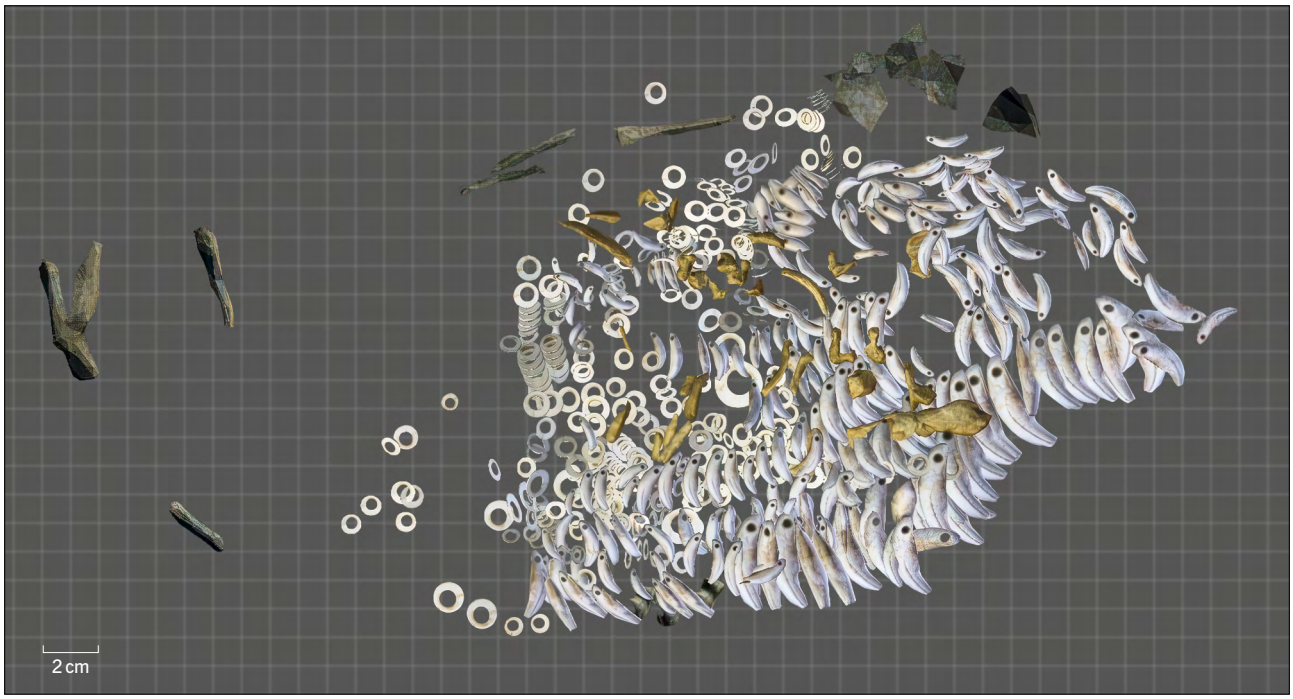



**Abb. 13** Wennungen, Bef. 2110. Innerhalb und außerhalb der Tasche befinden sich die Knochen eines Säuglings, dessen Kopf, Arme und Beine aus dem Tragesack herausragten (s. Abb. 7–8; 14; 49).

***Fig. 13*** *Wennungen, feature 2100. Inside and outside the bag are the bones of an infant whose head, arms and legs protruded from the carrying pouch (see Fig. 7–8; 14; 49).*

**Abb. 14** Wennungen, Bef. 2110. Die rechte Hand der erwachsenen Frau umfasst den Schädel des im Beutel getragenen Säuglings. Deutlich ist zu erkennen, dass Arme, Beine und Kopf – wie bei modernen Tragebeuteln – aus der Tasche herausragten (s. Abb. 7–8; 13; 49).

***Fig. 14*** *Wennungen, feature 2100. The adult woman's right hand cradles the skull of the infant carried in the pouch. It is clear to see that the arms, legs, and head protruded from the bag, as is the case with modern baby carriers (see Fig. 7–8; 13; 49).*

fähigen Alters Teil der repräsentativen Tracht junger Frauen wurden – und ihnen so persönlich gehörten, dass sogar eine Vererbung unwahrscheinlich war –, belegen beispielsweise die wohl während der Schwangerschaft verstorbenen Frauen aus den Oechlitzer Befunden 26615 (s. u. Abb. 36) oder 15109 (s. u. Abb. 32). Die Tragebeutel scheinen hierbei auf Lendenhöhe niedergelegt worden zu sein. Die Positionen von Oberarm (Humerus) und Unterarm (Ulna und Radius) zeigen, dass man der Verstorbenen den Arm auf bzw. entlang ihres durch die Schwangerschaft gewölbten Bauches

**Abb. 15** Profen, Bef. 7868 (Detail zu Abb. 2). Die enge Verzahnung der rechten Hand und der gereihten Hundecanini deutet an, dass die vor der Brust positionierte Tasche behutsam gehalten worden sein dürfte.

***Fig. 15*** *Profen, feature 7868 (detail to Fig. 2). The close interconnection of the right hand and the rows of canine teeth suggest that the bag positioned in front of the chest must have been held with care.*

gelegt hatte. Genau hier wurde während der Bestattungszeremonie und in Vorbereitung für den Weg ins Jenseits ihre individuelle Babytrage deponiert. Sogar das mit Muschelpailletten überlieferte schützende Tuch, das vermutlich die aus dem Tragebeutel herausragenden Körperteile wie Kopf, Arme und Beine der Neugeborenen bedeckte, legte man bei Grab 26615 aus Oechlitz genau in dieser Funktion bzw. Position ins Grab. Bei im Wochenbett oder später verstorbenen Frauen verläuft dieses Tuch vom Rücken über den oberen Rippenbogen und bedeckt die vor der Brust liegende Tasche bzw. das darin getragene Kind (vgl. Tab. 1).

Die Tragebeutel scheinen – entsprechend ihrer Lage im Grab – zu Lebzeiten vor dem Körper getragen worden zu sein. Ethnografische Vergleiche und auch verschiedene moderne Konventionen lassen auch an eine Art auf dem Rücken getragenen Sack denken. Doch dann wären die mit Tierzähnen ausgearbeiteten Taschen nur für die Reise ins Jenseits abgenommen und vor den Körper gelegt worden. Dagegen spricht zum einen die Positionierung bei den während der Schwangerschaft verstorbenen Frauen und zum anderen die mögliche Überlieferung von wirklich im Nacken oder auf dem Rücken getragenen Beuteln, wie es ein aufwendig ausgestattetes Frauengrab aus Profen anzeigt (s. Abb. 6). Eine Bestattung aus Karsdorf (Grab 59; s. u. Abb. 31), Burgenlandkreis, und ein weiteres Wennunger Begräbnis (Bef. 5036; s. u. Abb. 50) mit einem aus Knochenstäben aufgebauten Objekt lässt den Gebrauch kleinerer im Nacken oder Rücken getragener Säckchen diskutieren.

Der Besitz der arbeits- und kostenintensiven, reich verzierten Taschen war sicherlich einer eng definierten, elitären Gesellschaftsschicht vorbehalten. Eine möglicherweise gleichfalls besondere Ausgestaltung der Grabkammer, wie es Steinkisten oder -rollierungen anzeigen, ist nicht bekannt. Die Auswahl der Grabposition in der Kulturlandschaft dürfte hingegen, wie die sehr mühsamen Ausschachtungsarbeiten im ausbeißenden Zechstein von Friedrichsschwerz (s. Abb. 16a) zeigen, eine große Rolle gespielt haben.

Der flächenmäßig umfassendste Einblick in eine schnurkeramische Gesellschaft liegt mit den Ausgrabungen im Tagebau Profen vor; dort sind nur bei 1 % der Verstorbenen entsprechende Taschen überliefert[8]. Wer deren Produktion maßgeblich durchführte, ist nicht belegt – wenngleich die Beigabe spezieller Werkzeuge hierzu Aufschlüsse geben könnte. Vorstellbar wären beispielsweise Dickenbännlispitzen[9], doch sind derartige Objekte aus Mitteldeutschland bislang nicht bekannt. Gleichfalls ist unklar, über welchen Zeitraum hinweg die Hundezähne, insbesondere Canini

8 Für den Untersuchungsausschnitt von Oechlitz liegt ein fast zehnfach höherer Anteil vor; der räumlich auf eine Neubautrasse beschränkte Korridor könnte bei statistischen Auswertungen ein Auswahlartefakt widerspiegeln.

9 Dickenbännlibohrer, vgl. Hoffstadt 2005.

**Abb. 16a–b** Friederichsschwerz, Saalekreis, Bef. 180. a Für die Anlage einer schnurkeramischen Doppelbestattung wurde der anstehende Zechstein bis in 2 m Tiefe aufgebrochen. b Detail. Kupferplättchen und Bernsteinperlen (rot eingekreist) dürften die Applikation eines möglichen Kleidungsstückes gewesen sein.

***Fig. 16 a–b*** *Friedrichsschwerz, Saalekreis District, feature 180. a For the construction of a double burial from the Corded Ware Culture, the bedrock* Zechstein *was excavated to a depth of 2 m. b Detail. Copper plate and amber beads (circled in red) may have been the application of a possible item of clothing.*

**Abb. 17** Hohenmölsen, Burgenlandkreis, Ofengrube Bef. 10040. Zweigliedrige Ofenanlage mit zwei Hundedeponierungen (Individuum III [links] und IV [rechts]; s. Abb. 29).

***Fig. 17*** *Hohenmölsen, Burgenlandkreis District, kiln pit feature 10040. Two-part kiln system with two dog depositions (individuals III [left] and IV [right]; see Fig. 29).*

| | Ofen-anlage | Befund | Datierung | Indivi-duum | Geschlecht | Alter | Größe | Bemerkung |
|---|---|---|---|---|---|---|---|---|
| Hohenmölsen | 1 | 10040 | 29.–26. Jh. v. Chr | III | weiblich | 2 Jahre | 52 cm | trächtig |
| | | | | IV | männlich | erwachsen | 56 cm | Schnauzenbereich fehlt |
| Hohenmölsen | 2 | 10016 | 29.–26. Jh. v. Chr | I | männlich | erwachsen | 53 cm | |
| | | | | II | männlich | 2 Jahre | 50 cm | Schnauzenbereich fehlt, anthropogene Spuren |
| Hohenmölsen | | 151 | | 1 | unbest. | 5–6 Mon. | unbest. | Teilskelett (Jungtier) |
| Friedrichs-schwerz | 1 | 838/839 | 26.–24. Jh. v. Chr. | 1 | unbest. | unbest. | unbest. | keine Schneidezähne oder Eckzähne vorhanden, Schnauzenbereich nicht beurteilbar |
| | | | | 2 | unbest. | erwachsen | 55 cm | keine Schneidezähne oder Eckzähne vorhanden, keine Manipulation der Schnauze |
| | | | | 3 | unbest. | 18 Monate | unbest. | keine Schneidezähne oder Eckzähne vorhanden, Schnauzenbereich nicht beurteilbar |

**Tab. 2** Merkmale der innerhalb der schnurkeramischen Siedlungen Hohenmölsen und Friedrichsschwerz geborgenen Hunde.

***Tab. 2*** *Characteristics of the dogs recovered from the Corded Ware settlements of Hohenmölsen and Friedrichsschwerz.*

und Incisivi, beschafft wurden. Selbst die Prämolaren wurden nicht achtlos weggeworfen, sondern fanden ihre Verwendung bei zwar höchst beachtenswerten, aber wohl zweitrangigen Trachtbestandteilen. So sind durchlochte Backenzähne ähnlich wie Pailletten häufig im kopfnahen Bereich als Besatz von Tüchern zu beobachten und dürften den Saum mit Muschelpailletten besetzter Stoffe gebildet haben (s. Abb. 3).

**Abb. 18** Hohenmölsen, Ofengrube Bef. 10016. Dreigliedrige Ofenanlage mit zwei Hundedeponierungen (Individuum I [nördlich] und II [südlich]; s. Abb. 24).

***Fig. 18*** *Hohenmölsen, kiln pit feature 10016. Three-part kiln system with two dog depositions (Individuals I [north] and II [south]; see Fig. 24).*

Das an den für die Taschen verwendeten Zähnen ablesbare junge Alter der Hunde belegt ihr planmäßiges Töten (Tab. 2)[10]. Dabei dürfte das Herausbrechen der zukünftigen Schmuckobjekte aus dem Kiefer als rituelle Handlung einzustufen sein, wie die sorgfältigen bzw. inszenierten Deponierungen der Hunde von Hohenmölsen, Burgenlandkreis, anzeigen (Abb. 17–18). Man platzierte die Hunde in für die damalige Zeit im mitteldeutschen Raum typische Ofengruben, wie auch bei dem beachtenswerten, drei Hunde umfassendes Ensemble von Friedrichsschwerz (Abb. 19). Es handelt sich um ein weitgehend auf den Raum des südwestlichen Sachsen-Anhalts und angrenzender Regionen beschränktes Phänomen von zwei- bis mehrkammerigen Öfen (Becker u. a. 2015, 715; Balfanz u. a. 2019, 501 Abb. 1). Datierbare Funde lassen sich in den Befeuerungsanlagen nur selten nachweisen; das spärliche Material ordnet diesen Befundtypus der Schnurkeramik zu[11]. Im Planum zeigen sich derartige Befunde als oval- bis achtförmige Doppelgrube oder als zwei unmittelbar nebeneinander liegende Gruben, die auf den ersten Blick scheinbar nichts miteinander zu tun haben. Die beiden Gruben sind unterirdisch durch einen Tunnel bzw. Schacht miteinander verbunden. Im Regelfall zeichnen sich am Grund einer der Gruben, der Brennkammer, Spuren einer Verziegelung ab, wie sie durch große Hitzeeinwirkung entsteht. Demnach handelt es sich hier offenbar um eine Art Brennkammer, in der ein Feuer entfacht wurde, wobei die zweite Grube und der Tunnel augenscheinlich der Luftzufuhr dienten. Gelegentlich bestehen die Anlagen aus drei Kammern (vgl. Hohenmölsen)[12]. Neben einer wohl ›technischen‹ Primärfunktion dienten

10 Bei den aus dem thüringischen Raum bekannten Kettenhockern wurde das junge Alter der Hunde mit sechs Monaten angegeben (Feustel u. a. 1966, 80–86) und abgekaute Zahnkronen, die auf alte Hunde hinweisen würden, sind selten (Bach u. a. 1975, 70–72).

11 Die mehrkammerigen Ofengruben ordnen sich häufig in einen frühen Abschnitt der schnurkeramischen Kultur ein – die beiden Niederlegungen in Hohenmölsen bestätigen diesen chronologischen Ansatz, der Befund aus Friedrichsschwerz hingegen nicht (Tab. 2). Betrachtet man die Beigaben und die Radiokarbondatierungen der mit Tierzahnapplikationen verzierten Taschen jener jungen Frauen aus dem Saale-Unstrut-Gebiet (Tab. 1) ergibt sich eine zeitliche Einordung in die späte erste Hälfte des 3. Jts. v. Chr. Alle erfassten Individuen mit Beigabe einer Tasche mit Tierzahnapplikationen sind als linksseitige Hocker beigesetzte Frauen. Rathmann/Wahl 2020 benennen für den älteren Abschnitt der Schnurkeramik eine fast strikte geschlechtliche Differenzierung.

12 Hinweise auf eine Funktion als Brennofen für Keramik sind bisher nicht bekannt, es wird aber in ersten Publikationen eine Verwen-

**Abb. 19** Friedrichsschwerz, Ofengrube Bef. 839. Westliche Brennkammer mit Deponierung von zwei Hunden und Mahlsteinen (s. Abb. 22).

***Fig. 19*** *Friedrichsschwerz, kiln pit feature 839. Western combustion chamber with deposition of two dogs and millstones (see Fig. 22).*

die Gruben später gelegentlich auch als Grabstätten. Weit häufiger als menschliche Skelette finden sich in den vormaligen Öfen Teile von Tierkörpern, zumeist vom Rind, wie auch Mahlsteine. Vor allem die Niederlegung voll funktionsfähiger Getreidemühlen deutet auf ein rituelles Geschehen hin (s. Abb. 19). Doch auch für die Tierniederlegungen trifft dies zu.

Bei einigen Hunden, insbesondere in Hohenmölsen, fällt vor allem eine intentionelle Bearbeitung der Schnauze auf (Nydahl/Oelschlägel 2024). Diese wurde, wie Hackspuren an Ober- und Unterkiefern belegen, gezielt abgetrennt – und zwar vor den großen Backenzähnen, wodurch die Entnahme der Schneide- und Eckzähne erleichtert wird. Auf diesen Vorgang sind wohl auch die Schnittspuren an einem Jochbein zurückzuführen (Abb. 26). Ausgewählt wurden junge Tiere mit einer Körperhöhe von 50 cm (s. Tab. 2). Bislang sind nur zwei Hunde aus Hohenmölsen (Bef. 10016 und Bef. 10040) sicher mit herausgebrochenen Zähnen bekannt. Welche Tiere als Rohstofflieferanten vorrangig ausgewählt wurden, lässt sich aufgrund der kleinen bislang bekannten Zahl nicht erkennen. Gleichfalls unbeantwortet bleibt, ob die Hunde ausschließlich wegen ihrer Zähne gezüchtet oder wegen ggf. auffallend gut geeigneter Zähne dem Rudel vorzeitig entnommen wurden.

Wo wurden die anderen, sicherlich Hunderte von Hunden entsorgt, die ihre Zähne für die Herstellung der Taschen hergaben? Nicht auszuschließen ist, dass die für die Taschenapplikation erforderlichen Elemente von weiter her eingetauscht worden waren[13]. Mitglieder jener gesellschaftlichen Schicht, zu deren Trachtausstattung eine mit Tierzähnen

dung zum Räuchern von Fleisch (»Räucherofen«) oder auch zum Darren von Getreide in Betracht gezogen (Balfanz/Herbig 2024). Funktional vergleichbare Anlagen in Form von Doppelgruben sind – wenn auch kleiner dimensioniert – in der Ethnologie bzw. der modernen Survival-Szene als Tunnelgruben- oder Dakota-Feuer geläufig (<https://www.outdoornet.de/survival/dakota-fire-hole> [13.06.2025]). Ähnlich einem Schmiedefeuer, in dem die für das Feuer erforderliche Sauerstoffzufuhr durch einen Blasebalg erfolgt, brennt ein solches Feuer mit weit höheren Temperaturen, als dies bei einem landläufigen Lagerfeuer der Fall ist. Bei den steinzeitlichen Befunden handelt es sich demnach wohl um Anlagen, die mit dem Ziel errichtet wurden, in der Brennkammer eine möglichst hohe Temperatur zu erzeugen. Da beim Kalträuchern Temperaturen von 15–25°C angestrebt werden und für das Heißräuchern 50–85°C ausreichen, muss die Funktion dieser Doppelgruben als ›Räucherofen‹ sicherlich noch einmal hinterfragt werden. Auch zum Trocknen von Getreide wären die hier erzeugten Temperaturen viel zu hoch und der gewünschte Effekt einer moderaten Temperatur zur Erhaltung der Keimfähigkeit wäre mit weit einfacheren Mitteln zu erreichen.

13 Isotopenuntersuchungen an den einzelnen Zähnen wurden bislang nicht veranlasst. Der mitteldeutsche Raum mit seinen Lössböden bzw. dem glazialen Untergrund verspricht bei vorliegender Fragestellung keine eindeutige Endbewertung.

applizierte Tasche gehörte, wurden bislang in keiner Region außerhalb der engen mitteldeutschen Kernzone zweifelsfrei erkannt[14]. Möglicherweise blieben die betreffenden Damen stets in ihrer unmittelbaren Heimatregion – es sei denn, man hätte andernorts diese persönliche, wohl unvererbbare Insignie den Verstorbenen nicht mit ins Grab gegeben, sondern die Tasche weitergegeben oder -verwendet.

Demnach lag die Hauptproduktionsstätte für derartige Accessoires im Saale-Unstrut-Gebiet. Allerdings belegt die größere Verbreitung der klassischen Kettenhocker – linear an apikaler Durchlochung aufgereihte Tierzähne als Bördelung von Decken –, dass die nur aus der Region zwischen Unstrut, Weißer Elster und unterem Saaletal bekannten hochwertigen Taschen nicht an benachbarte Gemeinschaften gegeben wurden und sich ein Tauschhandel wohl auf Decken oder Mäntel beschränkte. Über alle Zeiten hinweg lassen sich vor allem an lokal typischen Trachtelementen sog. Heiratsbeziehungen nachweisen. Erstaunlicherweise finden sich außerhalb der Kernzone bislang keinerlei Belege für die mit Tierzähnen verzierten Taschen. Es überzeugt nicht, dass eine mit einer höchstwertigen Tasche ausgestattete, sozial höher gestellte Frau niemals ihre Heimatregion verlassen haben soll oder zumindest die persönliche Tasche niemals in die neue Heimat mitgenommen hätte. Wahrscheinlicher erscheint, dass die Tragebeutel nicht nur eine lokale Bedeutung zwischen Saale und Unstrut hatten, sondern dass diese Prestigeobjekte ausschließlich in dieser Gegend als persönliche Ausstattung angesehen wurden und andernorts möglicherweise an die Töchter weitergegeben wurden oder anderweitig bis zur Auflösung des Materials Verwendung fanden.

## Fundnachweise

Alle schnurkeramischen Gräber, in denen sich Hinweise auf mit Tierzähnen etc. bestickte Taschen finden, sind als Umzeichnung dargestellt. Bei flächenhaften Fundplätzen sind Planübersichten zusätzlich beigefügt. Bei nur im Zuge von Neubautrassen ausschnitthaft erfassten Fundplätzen wird aufgrund der geringen Aussagekraft zur Verteilung auf eine Plandarstellung verzichtet. Die Befunddarstellungen konzentrieren sich auf ausgewählte Merkmale und stellen keinen klassischen Katalog dar. Gleiches gilt für die Kurzskizzen zu den jeweiligen Fundplätzen.

Für Befunde mit niedergelegten Hunden, deren Schnauzenbereich deutliche Kennzeichen für die Entnahme der Front- und Eckzähne tragen, wurden ausführlichere Beschreibungen vorgenommen. Die dargestellten Merkmale sind im archäologischen Fundmaterial bzw. im Grabungsalltag nicht ohne Weiteres zu erkennen. Darum sind, um eine Vergleichsbasis für andere Komplexe zu bieten, die diesbezüglichen Darstellungen ausführlicher.

## 1 Friedrichsschwerz, Saalekreis

*Björn Schlenker, Susanne Friederich, Johanna Kleinecke, Christian Lau, Dorota Łukaszewska*

2019 fanden im Vorfeld erweiterter Baumaßnahmen an der zukünftigen Autobahn A 143 archäologische Untersuchungen statt. Südwestlich von Friedrichsschwerz, Saalekreis, kamen zehn schnurkeramische Ofengruben und Bestattungen zum Vorschein (Abb. 20)[15]. In vier dieser Anlagen zeichnen sich Deponierungen ab (Abb. 19); in einem Fall wurden drei Hundekörper niedergelegt (s. Tab. 2). In nur 300 m Entfernung liegen schnurkeramische Bestattungen. Lokal beißt Zechstein bis zur Oberfläche aus. Genau dort wurde eine schnurkeramische Doppelbestattung angelegt. Dabei wurde bis in mindestens 2 m Tiefe das Gestein herausgebrochen (vgl. Abb. 16).

### *Grab 180 (Abb. 21)*

Doppelbestattung. Beide Individuen sind Nordost-Südwest orientiert als linksseitige Hocker hintereinander liegend bestattet. Der Befund wurde *en bloc* geborgen und bislang nicht vollständig freigelegt. Die nachstehenden Informationen sind als vorläufige Hinweise zu verstehen.

Über beiden Personen lag jeweils ein Tuch, erkennbar an zahlreichen aus Muscheln gefertigten Pailletten. Bei Individuum 2 befindet sich der Stoff zwischen unterem Rippenbogen und der Lende; der Rand des Tuches ist mit durchlochten Hundebackenzähnen gefasst. Vor der Brust befinden sich zwei aus Knochen gefertigte, drei- und fünffach durchbohrte Kettenschieber. Zusammen mit einer schräg über den Körper verlaufenden, aus sieben Bernsteinperlen aufgebauten ›Kette‹ wird ein aufwendiger Schmuck oder Kleidungsbesatz angezeigt. Ähnliches ist auch bei Individuum 1 zu beobachten. Dort zeichnen fast 20 Bernsteinperlen im Zusammenspiel mit wenige Millimeter großen Kupferplättchen möglicherweise den Besatz eines Mantels an (Abb. 16b). Dieser ist teilweise über eine vor der Brust platzierte Tasche gerutscht. Acht Reihen von Tierzähnen zeigen eine Mindestgröße von 30 x 15 cm an. Vor dem Gesichtsbereich ist ein Teil des mit Hundeeckzähnen versehenen Gurtbandes erhalten. Die Tasche lässt sich aufgrund des aktuellen Standes der Befundfreilegung nicht abschließend erkennen. Auf dem Tragebeutel befindet sich derzeit ein vermutlich seitlich hineingerutschtes, zerscherbtes Keramikgefäß. Zwei weitere Gefäße befinden sich jeweils ca. 10 cm von den beiden Schädeln entfernt unmittelbar an der Querseite der Grablege.

14 Für den thüringischen Raum liegen über 100 Jahre zurückliegende Grabungsaufzeichnungen vor, die mögliche Hinweise auf mit Tierzähnen bestickte Taschen geben könnten (vgl. Fußnote 6).

15 1. Dokumentationsabschnitt 2018/2019: Akt.-Nr. 1262, Grabungsleitung M. Schaller. 2. Dokumentationsabschnitt 2021: Akt.-Nr. 14717, Grabungsleitung D. Łukaszewska, C. Lau. Schon bei den Ausgrabungen im Vorfeld der Norderweiterung der BAB 143 westlich von Halle (Saale) im Jahr 2006/2007 konnten bei der Ortschaft Gimritz, Saalekreis (Akt.-Nr. 784), in zwei Bereichen vier Ofengruben freigelegt werden (Autze/Jarecki 2019; Balfanz u. a. 2019). Nach Wiederaufnahme der Baumaßnahmen ab 2019 kamen sowohl im Umfeld der beiden bereits bekannten Fundstellen als auch weiter südwestlich bei Friedrichsschwerz, Saalekreis, bislang zehn weitere Befunde zutage, von denen mindestens vier direkt mit rituellen Vorgängen in Zusammenhang gebracht werden können.

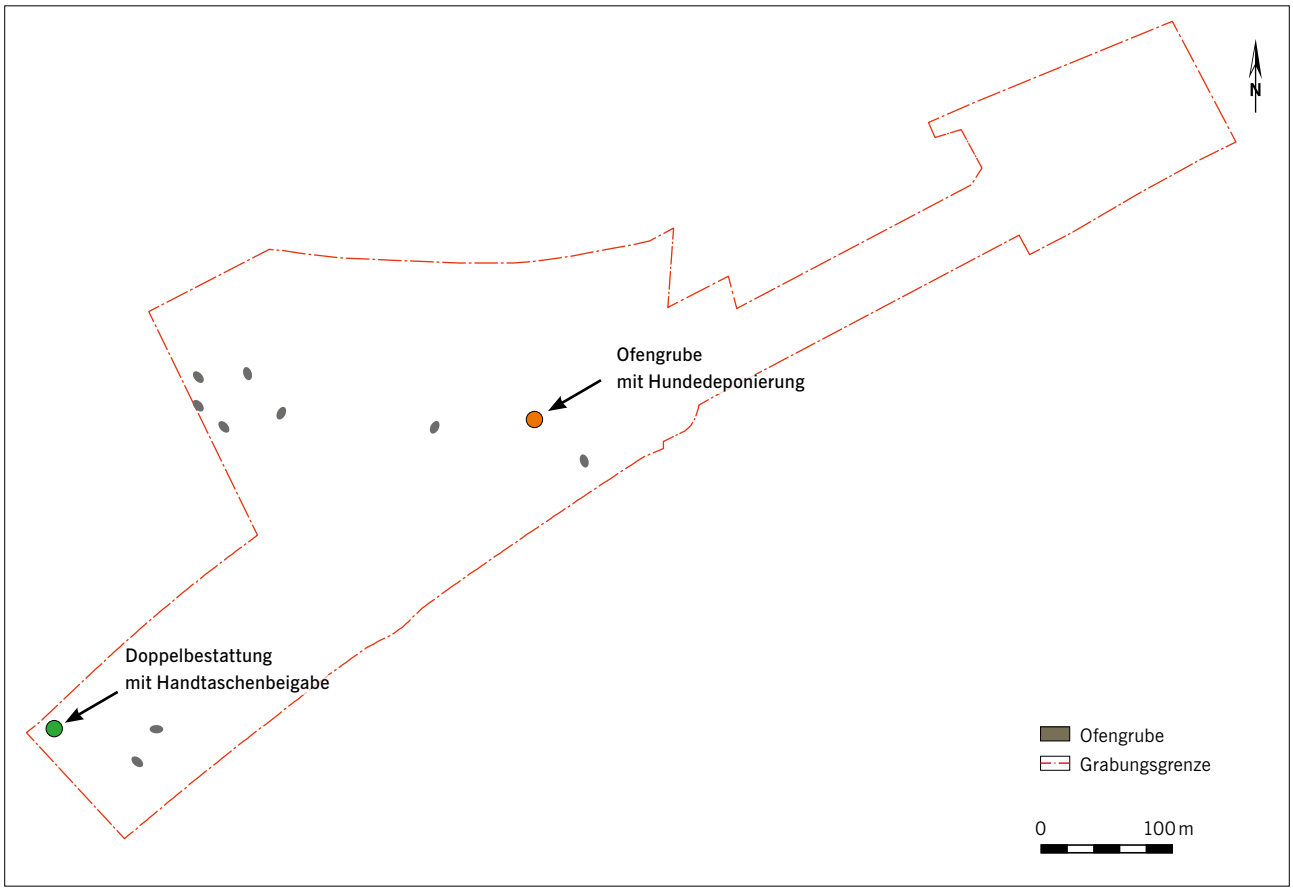
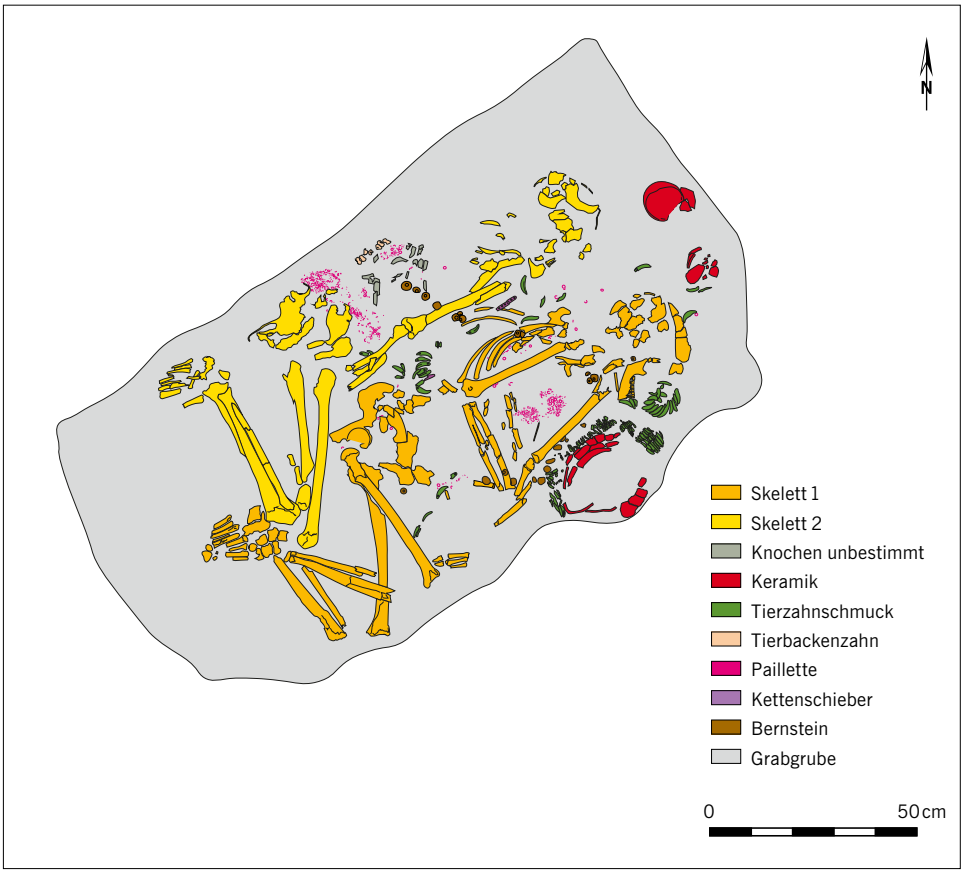



**Abb. 20** Friedrichsschwerz, Saalekreis. Übersichtsplan, schnurkeramische Nutzungsphase.

***Fig. 20*** *Friedrichsschwerz, Saalekreis District. Site plan, Corded Ware phase.*

**Abb. 21** Friedrichsschwerz, Bef. 180. Umzeichnung.

***Fig. 21*** *Friedrichsschwerz, feature 180. Drawing.*



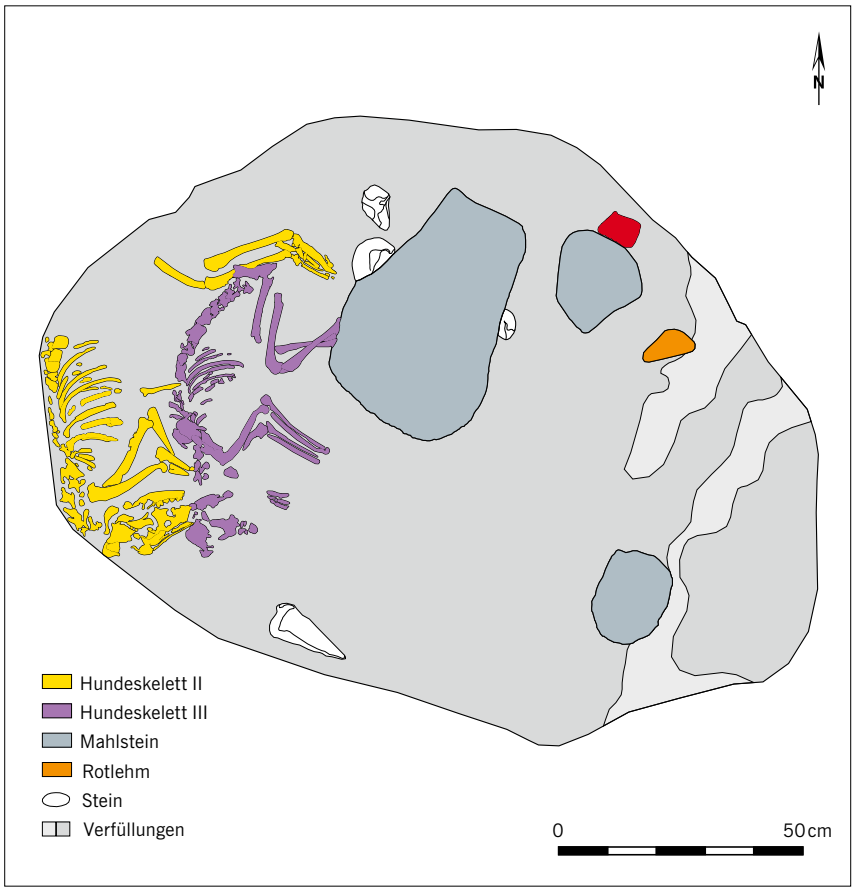



**Abb. 22** Friedrichsschwerz, Ofengrube Bef. 839. Umzeichnung der westlichen Brennkammer (s. Abb. 19).

***Fig. 22*** *Friedrichsschwerz, kiln pit feature 839. Drawing of the western combustion chamber (see Fig. 19).*

*Zweigliedrige Ofenanlage 1 (Bef. 838, 839) (Abb. 19; Abb. 22)*

Im Planum als zwei dunkelbraun bis schwarz verfüllte Einzelgruben erkennbar; Durchmesser je ca. 1,25–1,55 m; Brennkammer (Bef. 839; 10 cm starke Verziegelung bzw. Ascheschicht auf der Sohle) über Tunnel mit zweiter Grube (Bef. 838) verbunden. Diese Belüftungskammer liegt im Osten der 4,2 m langen West-Ost orientierten Gesamtanlage. Homogene, dunkelgraue bis schwarze Verfüllung im Deponierungshorizont wenige Zentimeter über Sohle.

Eingekeilt zwischen einigen offenbar gezielt niedergelegten Feldsteinen liegt der rund 30 cm lange Hornzapfen eines Ochsen. Circa 40 cm darüber Skelettreste von drei mittelgroßen Hunden. Zuoberst liegendes Individuum (Hund I) über einzelne schlecht erhaltene Schädelknochen belegt. Die beiden anderen Skelette sind fast vollständig; Erhaltung mäßig. Es wird der Eindruck einer liebevollen Niederlegung vermittelt. Bei Hund II sind in Ober- und Unterkiefer keine Eck- und Schneidezähne mehr vorhanden. Der Kieferbereich ist aber gut erhalten. Durch Bioturbation verlagerte Zähne lagen nicht in der Verfüllung. Bei den anderen beiden Tieren (I, III) verhindert der mangelhafte Erhaltungszustand der Schädel eine fundierte Beurteilung. Auffällig ist jedoch, dass im Gesamtmaterial der Verfüllung keine Eckzähne und die großen Incisivi der Hunde vorhanden waren. Für dieses Fehlen können keine taphonomischen Gründe angeführt werden, da die anderen Zähne sich gut erhalten haben. Eine vorsätzliche Extraktion der betreffenden Zähne vor dem Ablegen der Tiere kann also nicht ausgeschlossen werden. Weitere Deponierungen in der Ofenanlage: eine gut erhaltene und funktionsfähige Mahlplatte, vier Fragmente von Mahl- und Reibeplatten. Teilweise liegen diese Objekte auf den Pfoten der Hunde, sodass von einer zeitnahen Niederlegung auszugehen ist.

$^{14}$C Hund 1: MAMS 73221: 3968 ± 21 BP, cal BC 2560–2464 (68 %) bzw. cal BC 2571–2357 (95 %)

## 2 Hohenmölsen, Burgenlandkreis

*Carola Oelschlägel, Susanne Friederich, Xandra Dalidowski*

Im Zuge der Erschließung des Wohngebietes »Am Gymnasium« in Hohenmölsen, Burgenlandkreis[16], wurde ein von Löss geprägtes, seit dem Mittelneolithikum immer wieder genutztes Areal ausschnitthaft untersucht. Die Fläche liegt auf einem zu einem kleinen Fließgewässer nach Süden abfallenden Hang. Der Wasserlauf der Jaucha verläuft in nur 200 m Entfernung.

16 1. Dokumentationsabschnitt 2021: Akt.-Nr. 15452, Grabungsleitung X. Dalidowski. 2. Dokumentationsabschnitt 2022: Akt.-Nr. 14301, Grabungsleitung X. Dalidowski, C. Oelschlägel.

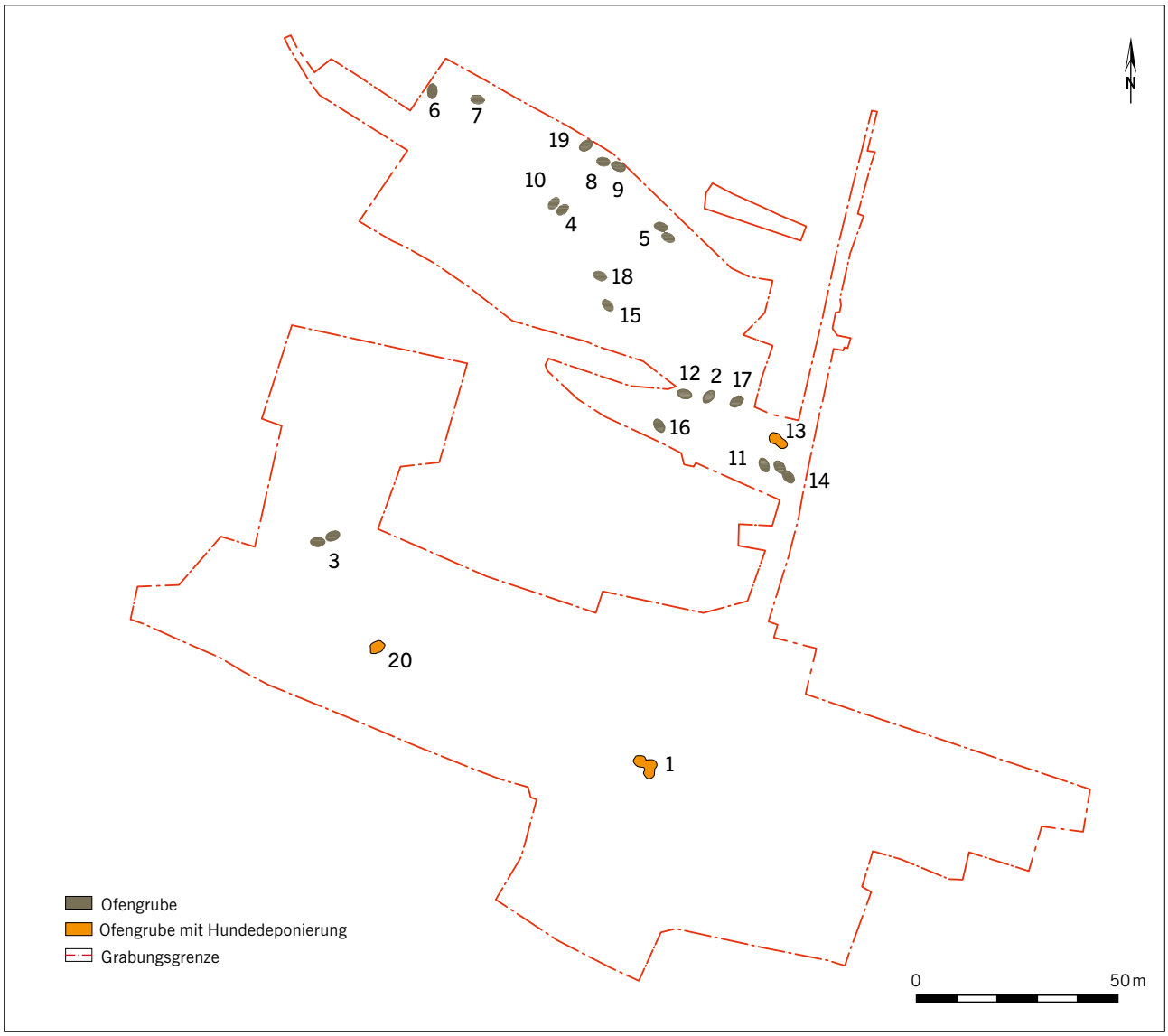



**Abb. 23** Hohenmölsen, Burgenlandkreis. Übersichtsplan, schnurkeramische Nutzungsphase (s. Tab. 3).

***Fig. 23*** *Hohenmölsen, Burgenlandkreis District. Site plan, Corded Ware phase (see Tab. 3).*

Während der schnurkeramischen Zeit wurden auf engem Raum ca. 20 mehrgliedrige Öfen angelegt (Abb. 23; Tab. 3) – im Planum als zwei separate Gruben oder in Form einer Acht erkennbar. Fast ausnahmslos sind die Ofenanlagen nach der Hauptwindrichtung, also Nordwest-Südost, ausgerichtet. Sie bestehen meist aus einer Brennkammer: Hohe Temperaturen verziegelten den Boden, auf dem sich hier am Fundplatz häufig mehrere Zentimeter starke Ascheschichten abgelagert haben. An diese Befeuerungsgrube schließt sich eine Kammer an; in Ausnahmefällen auch zwei. Sie weisen keine Hitzespuren auf. Wann und warum die Öfen aufgegeben wurden, ist noch unbekannt. Deutlich lässt sich hingegen die Nachnutzung erkennen. Bei zwei Anlagen von Hohenmölsen – Bef. 10016 (mit Teilbefunden 805, 806, 814) und 10040 (mit Teilbefunden 2445, 2450) – wurden vollständige Hundekörper, teilweise in ungewöhnlicher anatomischer Lage und mit intentionellen Veränderungen am Schädel deponiert. Bef. 151 führte gleichfalls ein Hundeskelett (Teilskelett). Inwieweit es sich um eine Ofenanlage handelte, kann aufgrund einer modernen Störung nicht eindeutig belegt werden.

### *Dreigliedrige Ofenanlage 1 mit zwei Hunden (Bef. 10016 mit Bef. 805, 806, 814) (Abb. 18; Abb. 24)*

Im Nordwesten kreisförmige Brennkammer, Dm. 1,0 m (Bef. 805, T: 65 cm, 6 cm starke Verziegelung bzw. Ascheschicht auf der Sohle); über 1,8 m langen Tunnel mit Luftzufuhrkammer 1 (Bef. 806, 1,50 x 1,25 m, T: 0,75 m) verbunden; geht in Luftzufuhrkammer 2 (Bef. 814, 1,4 x 1,2 m, T: 0,45–0,70 m) über; Gesamtgröße der Ofenanlage in Nordwest-Südost-Ausdehnung 4,5 m; in Nordnordost-Südsüdwest-Ausdehnung 3,5 m. Bef. 805 und 806 liegen in einer Nordwest-Südost verlaufenden Linie, Bef. 814 zweigt rechtwinkelig ab. T: 45–80 cm. Homogene dunkelbraungraue Verfüllung belegt schnellen Verfüllungsprozess oberhalb einer wenige Zentimeter über der Sohle der beiden Trockenkammern gelegenen Deponierung.

| | Befundnr. | Tierdepot |
|---|---|---|
| 1 | **10016** (805, 806, 814) | 2 Hunde |
| 2 | **10020** (2648) | |
| 3 | **10021** (188, 990) | |
| 4 | **10028** (714, 914, 2593) | |
| 5 | **10031** (2158, 2333, 2581) | |
| 6 | **10032** (2051, 2052) | |
| 7 | **10033** (2059, 2063) | |
| 8 | **10034.1** (2131, 2341) | |
| 9 | **10034.2** (2340) | |
| 10 | **10035** (2588, 2604) | |
| 11 | **10038** (2432, 2434) | |
| 12 | **10039** (2361, 2470, 2668) | |
| 13 | **10040** (2445, 2450) | 2 Hunde |
| 14 | **10042** (2437, 2439) | |
| 15 | **10043** (698) | |
| 16 | **10053** (2410) | |
| 17 | **2419** | |
| 18 | **530** | |
| 19 | **2495** | |
| 20 | **151** | Hund (Teilskelett) |

**Tab. 3** Hohenmölsen. Schnurkeramische Ofenanlagen (vgl. Abb. 23).

***Tab. 3*** *Hohenmölsen. Corded Ware kilns (see Fig. 23).*

Hundeindividuum I wurde mit dem Rücken, auf der rechten Seite liegend, vor der Mündung des Verbindungsganges deponiert. Es handelt sich bei diesem Tier um einen alten Rüden von 53 cm Schulterhöhe. Der deutlich jüngere Hund II erweckt aufgrund des verdrehten Körpers den Eindruck, dass bei seiner Niederlegung weniger Sorgfalt aufgebracht worden ist. Sein Skelett ist fast vollständig, doch fehlt der gesamte Schnauzenbereich (Abb. 25). Schnitt- und Zerteilungsspuren an den verbliebenen Schädelteilen belegen eine Manipulation. Am linken Jochbein zeichnen sich mehrere diagonal verlaufende Schnittspuren ab (Abb. 26). Sie könnten vom Häuten oder Durchtrennen des Musculus zygomaticus herrühren. An beiden Unterkiefern ließen sich weitere Spuren einer Zerteilung beobachten. Den linken Kiefer hatte man vor dem ersten Molar abgeschlagen, sodass dieser Zahn zerstört wurde (Abb. 27). Der rechte Kiefer weist eine analoge, wenngleich etwas schwächere Spur auf Höhe des vierten Prämolaren auf (Abb. 28). Form und Ausführung der artifiziellen Spur könnte durch ein Beil verursacht worden sein – demnach wäre die Schnauze vom restlichen Schädel abgehackt worden. Die ausgefransten Bruchkanten belegen, dass man diese Prozedur am frischen Knochen durchführte, d. h. beim oder unmittelbar nach dem Töten des Tieres.

Oberhalb des Deponierungshorizontes im Bereich der Einfüllung fünf Keramikscherben und zehn weitere Tier-

**Abb. 24** Hohenmölsen, Ofengrube Bef. 10016. Umzeichnung (s. Abb. 18).

***Fig. 24*** *Hohenmölsen, kiln pit feature 10016. Drawing (see Fig. 18).*

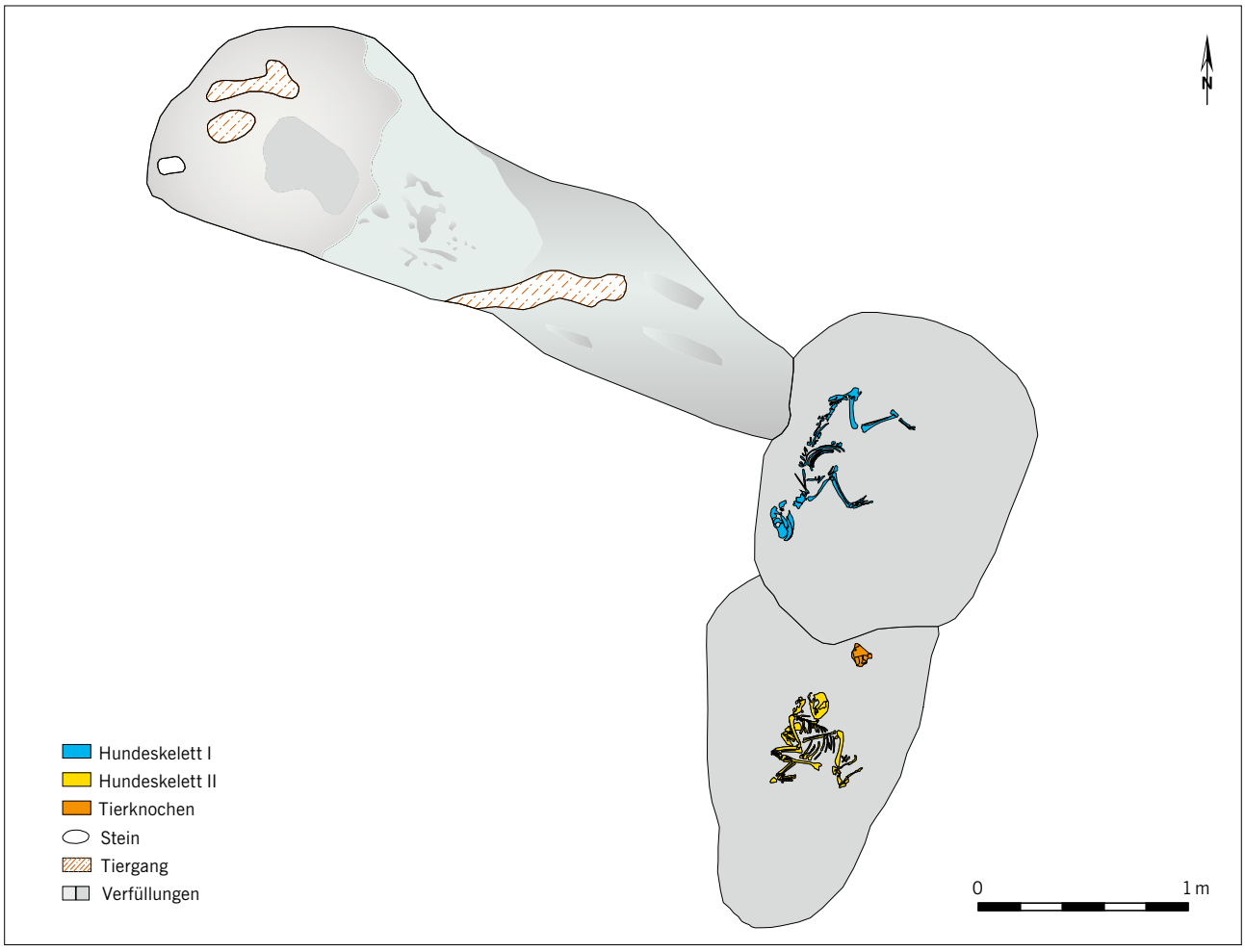


**Abb. 25** Hohenmölsen, Ofengrube 1 (Bef. 10016), Hund II. Schädel mit abgeschlagener Schnauzenspitze.

***Fig. 25*** *Hohenmölsen, furnace pit 1 (feature 10016). Skull of dog II with severed muzzle.*

**Abb. 26** Hohenmölsen, Ofengrube 1 (Bef. 10016), Hund II. Linkes Jochbein mit Schnittspuren.

***Fig. 26*** *Hohenmölsen, furnace pit 1 (feature 10016), dog II. Left cheekbone with cut marks.*

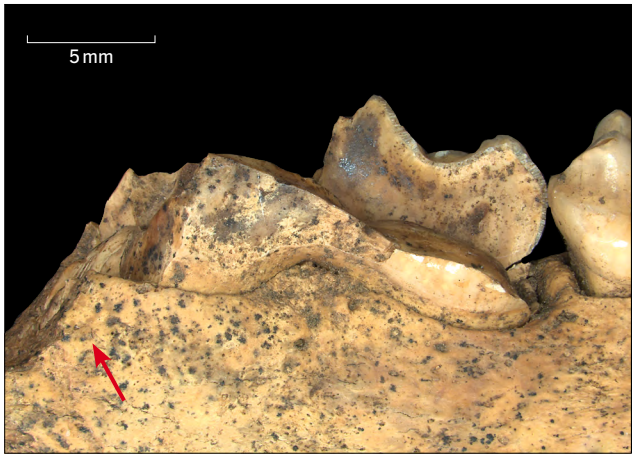



**Abb. 27** Hohenmölsen, Ofengrube 1 (Bef. 10016), Hund II. Hackspur am linken Unterkiefer, bukkale Ansicht.

***Fig. 27*** *Hohenmölsen, furnace pit 1 (feature 10016), dog II. Chop mark on the left lower jaw, buccal view.*

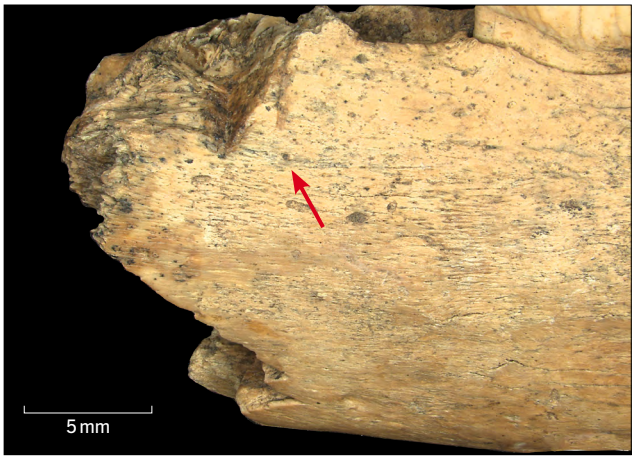



**Abb. 28** Hohenmölsen, Ofengrube 1 (Bef. 10016), Hund II. Hackspur am rechten Unterkiefer, linguale Ansicht.

***Fig. 28*** *Hohenmölsen, furnace pit 1 (feature 10016), dog II. Chop mark on the right lower jaw, lingual view.*

knochen. Bef. 805: Rind (n = 3), Schaf/Ziege (n = 1), Großsäuger (n = 1), unbestimmt (n = 2); Bef. 814: Großsäuger (n = 1); Bef. 10016: Rind (n = 2).

$^{14}$C Hund II: MAMS 76526: 4128 ± 20 BP, cal BC 2851–2631 (68 %) bzw. cal BC 2867–2583 (95 %) – Tierknochen

*Zweigliedrige Ofenanlage 13 mit zwei Hunden (Bef. 10040 mit Bef. 2445, 2450) (Abb. 17; Abb. 29)*

Im Planum zwei dunkelbraun bis schwarz verfüllte Einzelgruben; Durchmesser ca. 1,65 m und 1,30 m; Brennkammer (Bef. 2450; T: 75 cm; 10 cm starke Verziegelung der Sohle) über Tunnel mit einer Trockenkammer verbunden; Wandung annähernd senkrecht. Die von Südost nach Nordwest schräg abfallende Sohle der Trockenkammer (Bef. 2445; T: ca. 55–75 cm, dort lang-oval bis zu ca. 3,75 m) ermöglicht die für eine Ofenanlage erforderliche Luftzirkulation. Die homogene dunkelbraune bis schwarze humose Verfüllung belegt einen schnellen Verfüllungsprozess oberhalb einer ca. 10 cm über der Sohle verlaufenden Deponierung.

In der Brennkammer befindet sich Hundeindividuum III, am Übergang zur Belüftungskammer im Tunnelbereich Hundeindividuum IV. Vier Steine und ein fragmentierter Rinderunterkiefer liegen südöstlich von Hund III.

Bei Hund III handelt sich um eine trächtige, ca. zweijährige Hündin, die man auf der rechten Seite mit dem Rücken an der Grubenwandung abgelegt hatte. Für die zweite Deponierung fiel die Wahl auf einen deutlich älteren Rüden. Die Orientierung des Tierkörpers war Nordost-Südwest mit dem Kopf im Nordosten. Das Tier lag auf der rechten Seite, der vordere Körperbereich wie auch Hals und Kopf waren auf den Rücken bzw. auf die Stirn gedreht. Ein Stein war unter den Schädel geschoben worden (Abb. 30). Die Knochen des postcranialen Skelettes sind nicht fragmentiert. Am Oberschädel fehlt hingegen seit der Niederlegung der Schnauzenbereich (Os incisivum, Teile von Os maxillare, Os nasale). Von beiden Unterkiefern sind nur Fragmente aus dem hinteren Bereich (aboral) vorhanden. Wenngleich anthropogene Spuren an den Schädelresten nicht beobachtet werden konnten, spricht doch das Fehlen derselben Schädelteile wie bei Hund II aus Befund 10016 für eine gewollte Manipulation des Kopfes.

Neben den beiden Hundeskeletten wurden 29 weitere Tierknochen gefunden, die sich Rind (n = 9), Schaf/Ziege (n = 2), Großsäugern (n = 3) und mittelgroßen Säugern (n = 4) zuordnen lassen. Elf Knochenfragmente sind unbestimmt.

$^{14}$C Rinderknochen unterhalb Hund III: MAMS 76527: 4106 ± 20 BP, cal BC 2843–2583 (68 %) bzw. cal BC 2856–2575 (95 %) – Tierknochen

## 3 Karsdorf, Burgenlandkreis

*Susanne Friederich, Carola Oelschlägel, Björn Schlenker*

Im Vorfeld des Rohstoffabbaus wurde vor allem in den frühen 2000er-Jahren ein kleiner, ca. 20 Gräber umfassender Friedhof der schnurkeramischen Kultur dokumentiert (Behnke 2014; Friederich u. a. in Vorb.). Einer weiblichen Verstorbenen dürfte eine mit Tierzahnbesatz verzierte Tasche mitgegeben worden sein (Muhl/Schwarz 2022).

*Bef. 59 (Abb. 31)*

Doppelbestattung; zwei Personen sind mit Blick nach Süden niedergelegt. Individuum 1 (weiblich, erwachsen) ist Nordost-Südwest orientiert als linksseitiger Hocker bestattet. Als Beigaben zwei Becher, eine Schale, zwei Silices, ein Knochenröllchen.

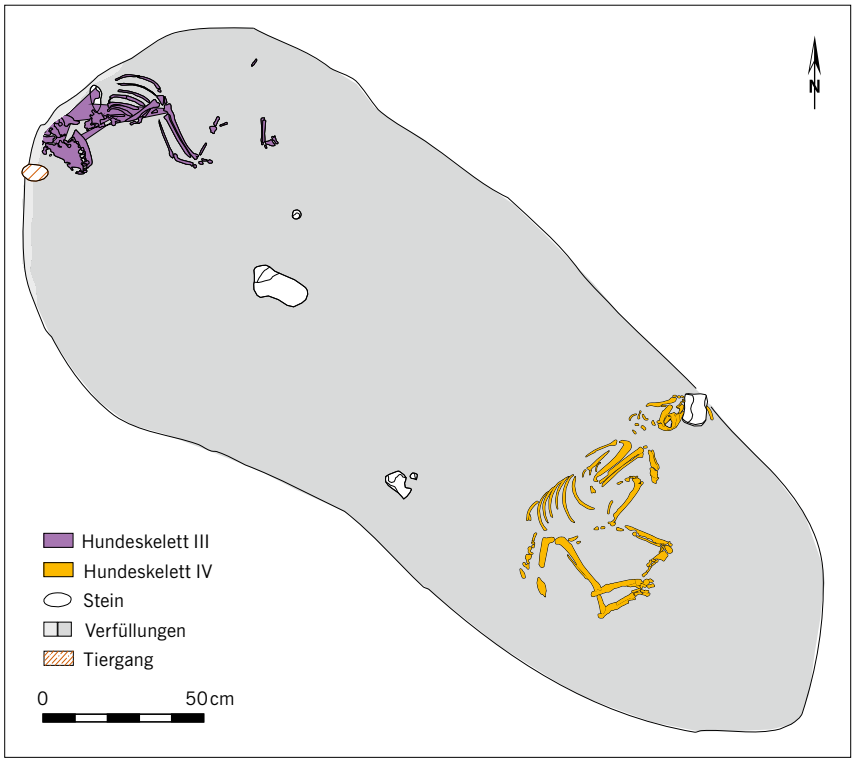



**Abb. 29** Hohenmölsen, Ofengrube Bef. 10040. Umzeichnung (s. Abb. 17).

***Fig. 29*** *Hohenmölsen, kiln pit feature 10040. Drawing (see Fig. 17).*

**Abb. 30** Hohenmölsen, Bef. 10040, Hund IV in leicht verdrehter Lage und fehlender Schnauzenpartie.

***Fig. 30*** *Hohenmölsen, feature 10040. Dog IV in a slightly twisted position with missing muzzle section.*

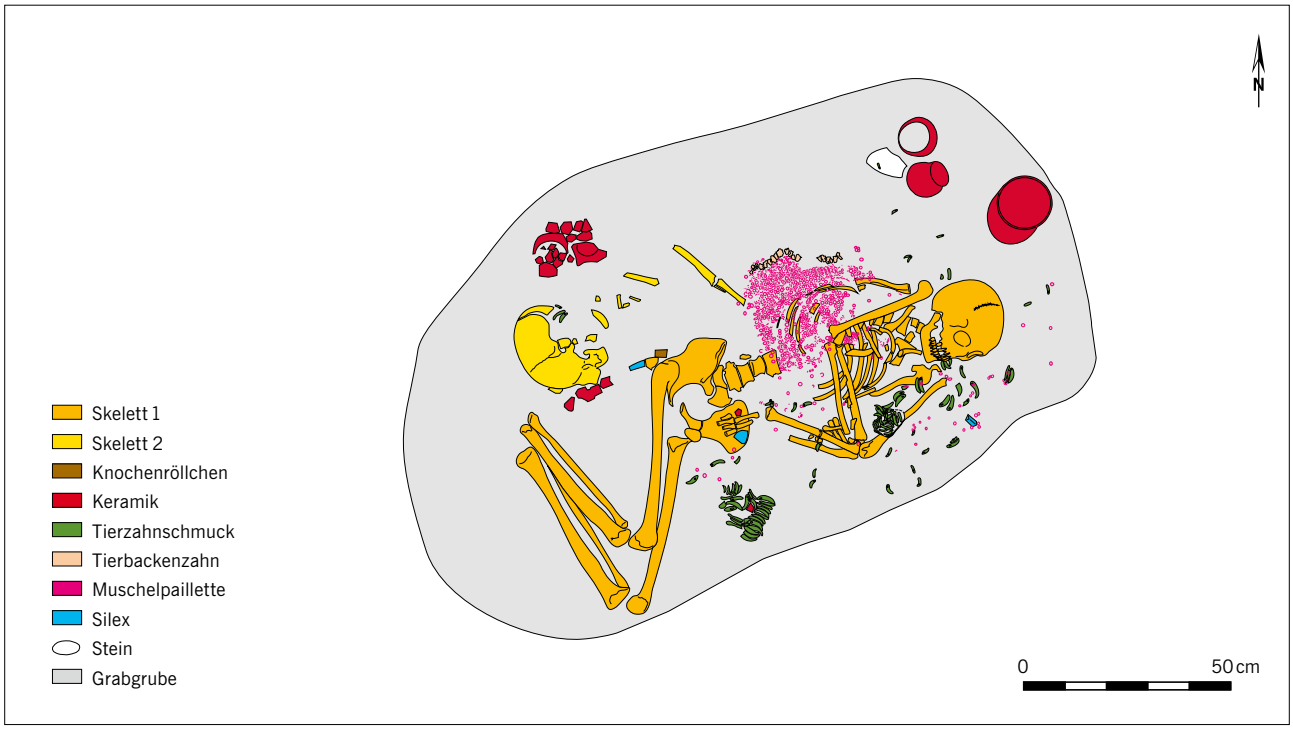



**Abb. 31** Karsdorf, Burgenlandkreis, Bef. 59. Umzeichnung.

***Fig. 31*** *Karsdorf, Burgenlandkreis District, feature 59. Drawing.*

Muschelpailletten im Rücken des Individuums werden vom örtlichen Grabungsleiter als Rucksack angesprochen. An linkem Oberarm und im Lendenbereich jeweils Konglomerat durchbohrter Hundezähne. Die fehlende lineare Reihung kann als mit Tierzähnen verstärktes Gurtband bzw. als ein mit durchbohrten Hundecanini applizierter Taschenkörper diskutiert werden. Im Beinbereich hinter Individuum 1 liegt Individuum 2 (Kind, vermutlich männlich), das Südwest-Nordost orientiert als rechtsseitiger Hocker bestattet ist. Gefäßreste, ein Silex, ein Gagat.

$^{14}$C: KIA 29549: 4163 ± 27 BP, cal BC 2784–2676 BC (68 %) bzw. cal BC; 2820–2662 BC (95 %)

## 4 Oechlitz, Saalekreis

*Susanne Friederich, Carola Oelschlägel, Björn Schlenker*

Im Vorfeld der ICE-Schnellbahntrasse Leipzig–Erfurt fanden innerhalb eines 50 m breiten Ausschnittes umfangreiche Geländearbeiten statt. Der Höhenrücken nördlich von Oechlitz, Saalekreis, war bereits in der Jungsteinzeit als Bestattungsplatz genutzt worden. Meist locker verstreut oder in kleinen Grabgruppen niedergelegt, wurden 158 schnurkeramische Bestattungen dokumentiert. Acht jungen Frauen waren mit Tierzähnen verzierte Taschen mit ins Grab gegeben worden (s. Tab. 1). Die Frauenbestattungen mit Taschenbeigabe sind als Überblickskatalog bereits vorgelegt (Menke u. a. 2017, 280–291), sodass in vorliegendem Beitrag nur die Umzeichnungen nochmals abgebildet werden.

### *Grab 15109 (Abb. 32)*

Ost-West orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt (vgl. Becker u. a. 2015, 731; Menke u. a. 2017, 281).

$^{14}$C: MAMS 111777: 4053 ± 28 BP, cal BC 2622–2496 (68 %) bzw. cal BC 2836–2481 (95 %) – Skelett

### *Grab 25334 Dreifachbestattung (Abb. 33)*

Dreifachbestattung; Ost-West orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; im hinteren Beinbereich Kind (infans II) als rechtseitiger Hocker niedergelegt; auf Position des angewinkelten Armes Kind (infans 1) (vgl. Becker u. a. 2015, 729; Menke u. a. 2017, 281).

$^{14}$C: MAMS 17174: 4002 ± 23 BP, cal BC 2566–2487 (68 %) bzw. cal BC 2573–2472 (95 %) – Tierknochen

### *Grab 25496 Doppelbestattung (Abb. 34)*

Doppelbestattung; Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; im Rücken- und hinteren Beinbereich Kind (infans II) als vermutlich rechtseitiger Hocker niedergelegt (vgl. Menke u. a. 2017, 283).

### *Grab 25570 (Abb. 35)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt (vgl. Menke u. a. 2017, 283–284).

### *Grab 26615 (Abb. 36)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; Position der mit Tierzähnen bestickten Tasche im Lendenbereich, Pailletten im tieferen Rückenbereich (vgl. Menke u. a. 2017, 284–285).

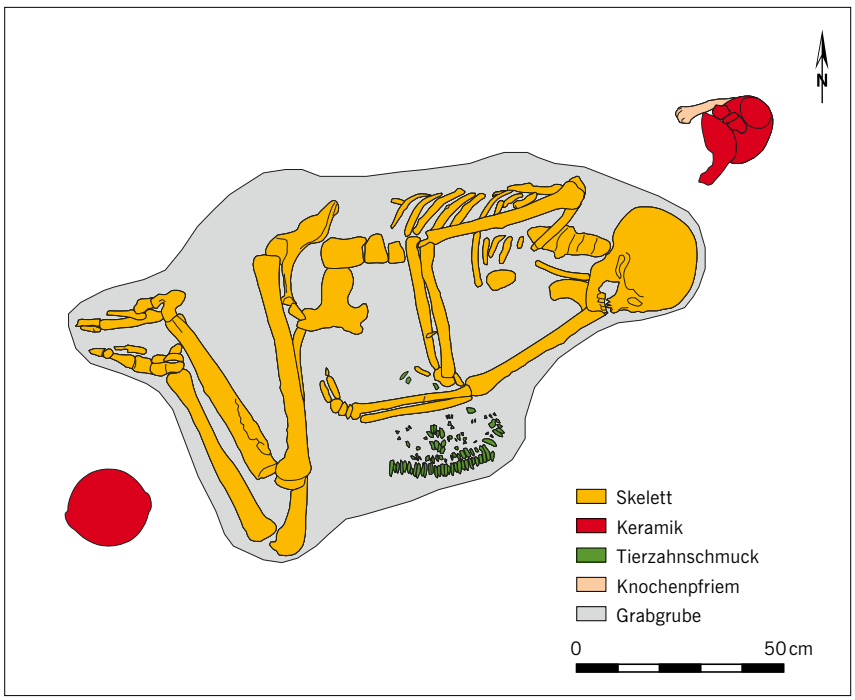



**Abb. 32** Oechlitz, Saalekreis, Bef. 15109. Umzeichnung.

***Fig. 32*** *Oechlitz, Saalekreis District, feature 15109. Drawing.*

**Abb. 33** Oechlitz, Bef. 25334. Umzeichnung.

***Fig. 33*** *Oechlitz, feature 25334. Drawing.*

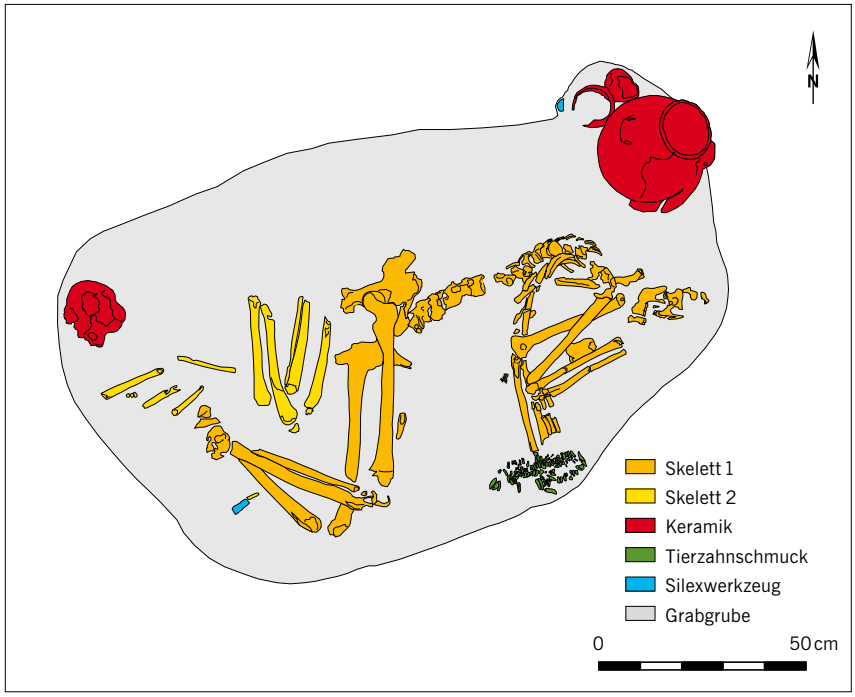



**Abb. 34** Oechlitz, Bef. 25496. Umzeichnung.

***Fig. 34*** *Oechlitz, feature 25496. Drawing.*

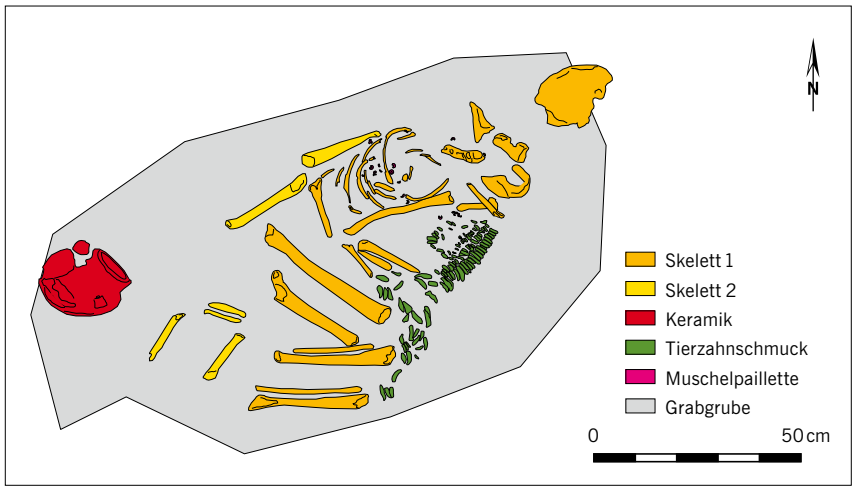



**Abb. 35** Oechlitz, Bef. 25570. Umzeichnung.

***Fig. 35*** *Oechlitz, feature 25570. Drawing.*

**Abb. 36** Oechlitz, Bef. 26615. Umzeichnung.

***Fig. 36*** *Oechlitz, feature 26615. Drawing.*

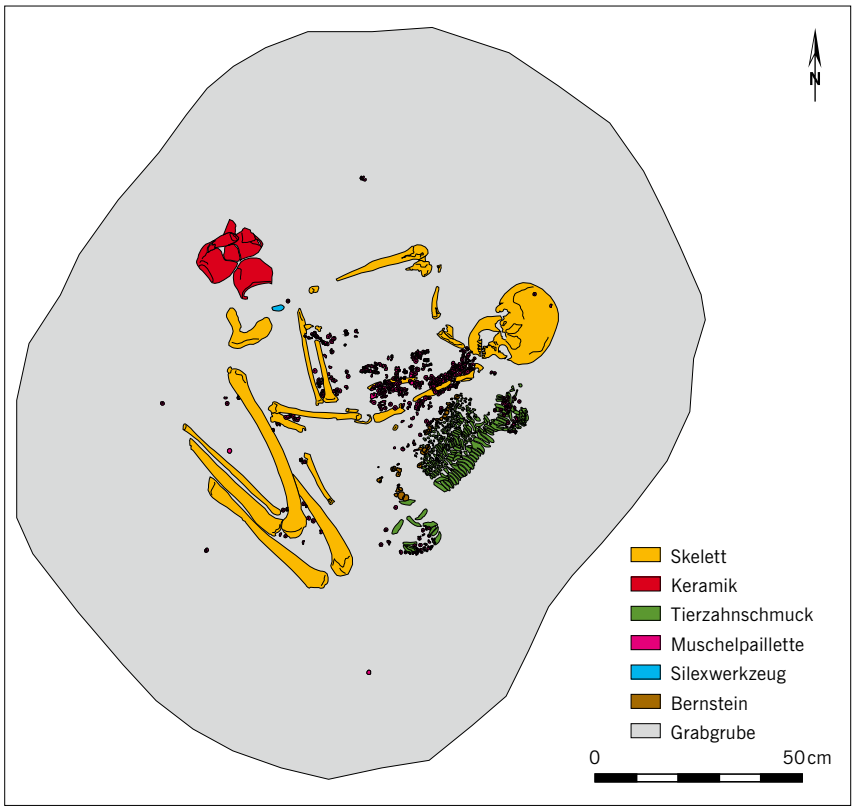



**Abb. 37** Oechlitz, Bef. 25815. Umzeichnung.

***Fig. 37*** *Oechlitz, feature 25815. Drawing.*

*Grab 25815 (Abb. 37)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; Position der mit Tierzähnen bestickten Tasche vor Brust, Pailletten im Brustbereich (vgl. Becker u. a. 2015, 733; Menke u. a. 2017, 286–287).

$^{14}$C: MAMS 21691: 4021 ± 25 BP, cal BC 2572–2491 (68 %) bzw. cal BC 2617–2473 (95 %) – menschliches Skelett

*Grab 20020 (Abb. 38)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; Position der mit Tierzähnen bestickten Tasche vor Brust; Bernstein im Lenden- und oberen Beinbereich Hinweis auf Mantelbesatz (vgl. Becker u. a. 2015, 729; Menke u. a. 2017, 287–288).

$^{14}$C: MAMS 21691: 4017 ± 26 BP, cal BC 2572–2489 (68 %) bzw. cal BC 2617–2472 (95 %) – menschliches Skelett

**Abb. 38** Oechlitz, Bef. 20020. Umzeichnung.

**Fig. 38** Oechlitz, feature 20020. Drawing.

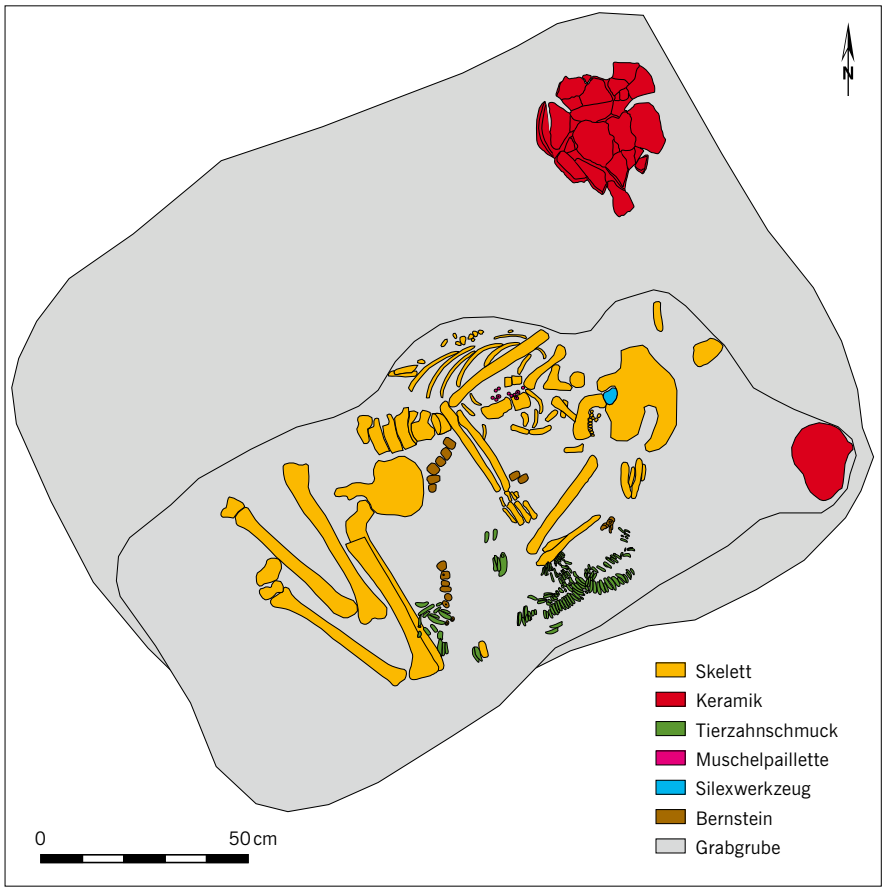
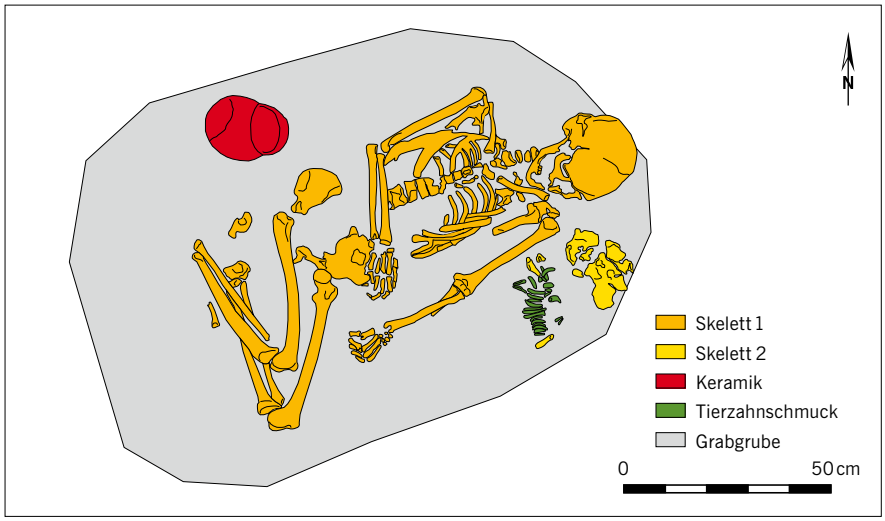



**Abb. 39** Oechlitz, Bef. 21827. Umzeichnung.

***Fig. 39*** *Oechlitz, feature 21827. Drawing.*




*Grab 21827 Doppelbestattung (Abb. 39)*

Doppelbestattung; Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; im vorderen Schulterbereich Kind (infans I–II), in diesem Abschnitt mit 24 durchlochten Hundezähnen Hinweis auf eine mit Caniden bestickte Tasche (vgl. Menke u. a. 2017, 290–291). Möglicherweise war die Grabstelle überhügelt.

## 5 Profen, Burgenlandkreis

*Susanne Friederich, Johanna Kleinecke*

Im Abbaufeld Profen-Schwerzau, Burgenlandkreis, wurde auf dem Pätschenberg und seinen südlichen Ausläufern während der schnurkeramischen Zeit intensiv gesiedelt, wie einige nur noch rudimentär überlieferte Hausgrundrisse, 30 Ofengruben und 300 Bestattungen anzeigen (Abb. 40). Einige scheinen separat zwischen kleineren Friedhöfen und bis zu 80 Gräber umfassenden Nekropolen gelegen zu haben (Jacobi 2015; Friederich 2022b; Friederich 2025). Die für vorliegenden Beitrag relevanten Ausgrabungen fanden von 2006–2012 statt.

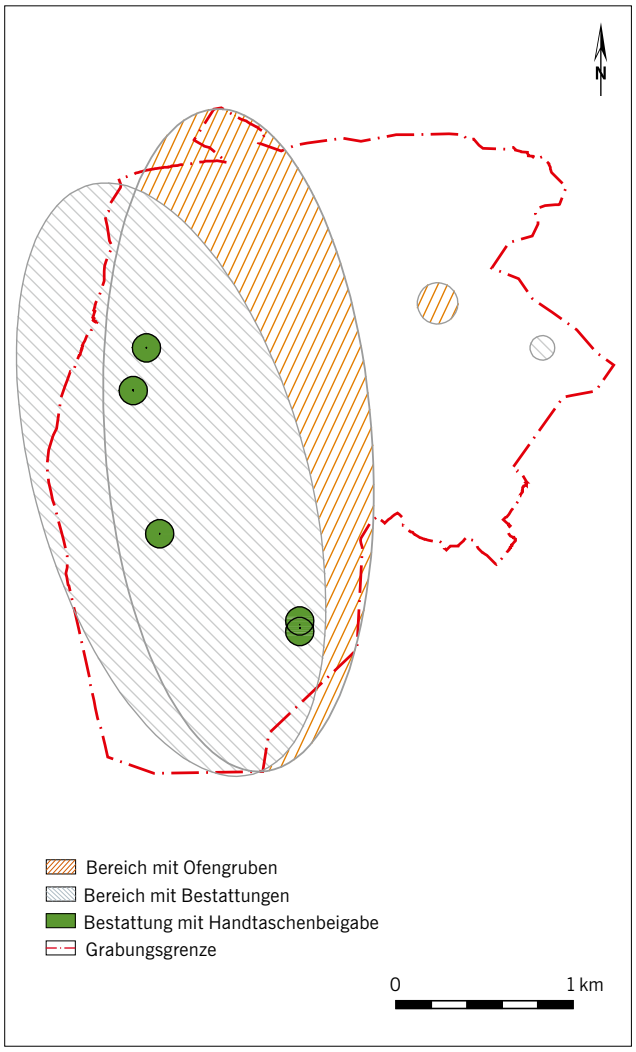



**Abb. 40** Profen, Burgenlandkreis. Übersichtsplan, schnurkeramische Nutzungsphase.

***Fig. 40*** *Profen, Burgenlandkreis District. Site plan, Corded Ware phase.*

*Bef. 5117 (Abb. 41)*

Ost-West orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; Schädel und Beinknochen gut erhalten; Oberarme nur bruchstückhaft; einige Rippen vorhanden; weitere Knochen fehlen.

Bei der Geländearbeit zeichnete sich, vor dem Körper liegend, eine Vielzahl von Zähnen ab; unklar war die exakte Reihung. Zum Zeitpunkt der Entdeckung (2009) war noch von keinem anderen Fundplatz eine mit Tierzähnen besetzte beutelartige Tasche bekannt. Ein Teilbereich mit dicht gereihten, dachziegelartig angeordneten Tierzähnen wurde als Teilblock geborgen (s. Abb. 9). Vergleichbar wurde mit einer langen Reihung von Hundemolaren verfahren. Die vor dem Bauch deponierte Tasche war, orientiert an den Tierzähnen, 25 x 18 cm groß; 12 Reihen sind erhalten. In der Position zwischen Rippen und Becken verläuft im Rückenbereich eine aus mindestens 15 Molaren gebildete Kette (s. Abb. 3). Zusammen mit mehreren Bernsteinperlen (s. Abb. 5) deuten sie einen quer über den Körper verlaufenden Stoff von ca. 20 cm Breite an.

*Bef. 5307 (Abb. 42)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt. Der Befund wurde in Detailabschnitten geborgen und nach Beeinträchtigung durch das Saale-Flutereignis 2013 nochmals präpariert.

Vor dem Gesichtsschädel zweireihig überlappender, 35 cm langer Strang dicht beieinanderliegender durchbohrter Hundeeckzähne. Ihrer Anordnung und Lage im Grab nach zu urteilen, handelt es sich um ein mit Tierzähnen verstärktes bzw. verziertes Gurtband einer Tasche (s. Abb. 11). Dies war entweder nicht durchgehend appliziert oder entsprechende Elemente sind aufgrund der generell schlechten Erhaltungsbedingungen bei dieser Grablege vergangen.

*Bef. 7844 (Abb. 43)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; schlecht erhalten; nur Schädel, ein Arm bruchstückhaft, beide Oberschenkel fragmentiert.

Vor dem Oberkörper Hinweise auf eine mit möglicherweise in sechs aus Tierzähnen aufgebauten Reihen bestickte Tasche; bessere Erhaltung im Bereich der beiden Gurtbänder; diese im Anschlussbereich an Taschenkörper mit mindestens zwei aus durchlochten Hundecaniden aufgebauten Reihen verziert.

*Bef. 7868 (Abb. 44)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt (s. Abb. 2; 15); Tierzahnkette; weiblich, 25–30 Jahre.

Die Tierzähne lassen sich aufgrund ihrer Anordnung im Kniebereich als Besatz einer Decke, auf Position der rechten Hand als Tasche bzw. deren Gurtband interpretieren.

*Bef. 8118 (Abb. 45; s. Abb. 6)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt.

Vor der Brust liegt eine mit zahlreichen durchbohrten Hundezähnen verzierte Tasche. Die dicht beieinander liegenden Zähne sind dachziegelartig zueinander positioniert (vgl. hierzu die Darstellung im Einleitungsteil). Aus der Anzahl der am häufigsten vertretenen Zähne, den 3. oberen Incisivi (ca. 69), ergibt sich rechnerisch eine Individuenzahl von mindestens 35 Hunden. Die ca. 107 oberen und unteren Eckzähne stammen von mindestens 27 Hunden.

Der Kopfbereich war mit einem Tuch bedeckt, wie zahlreiche Muschelpailletten nahelegen. 14 durchbohrte Molaren von Hunden (darunter fünf massige, obere erste Molare mit jeweils drei Wurzeln) dürften zu einem anderen Accessoire gehört haben oder eine andere Funktion des vermeintlichen Objektes andeuten. Die Position im Nackenbereich und in Verbindung mit Pailletten ähnelt der Situation von Grab 59 von Karsdorf; dort spricht der Ausgräber von einem Rucksack.

**Abb. 41** Profen, Bef. 5117 Umzeichnung.

***Fig. 41*** *Profen, feature 5117. Drawing.*

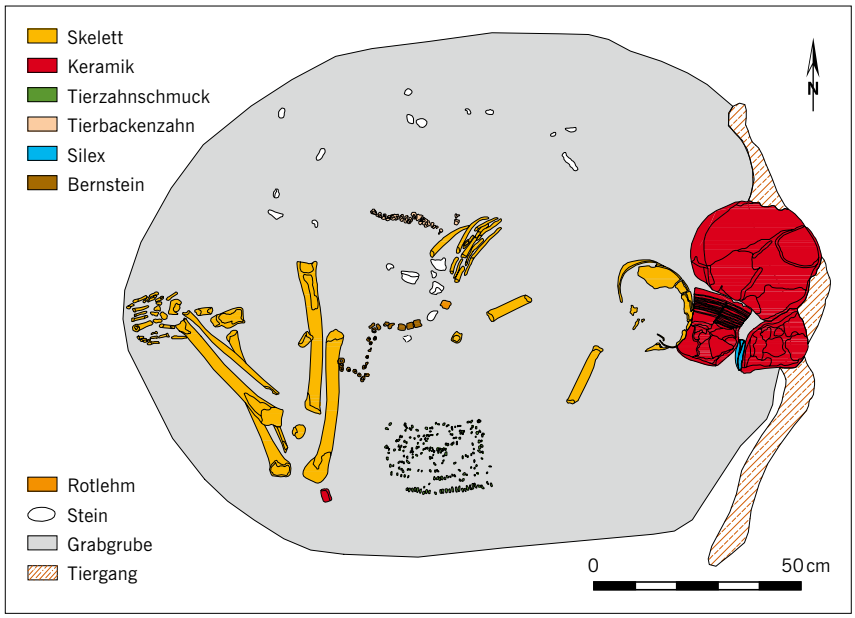



**Abb. 42** Profen, Bef. 5307. Umzeichnung.

***Fig. 42*** *Profen, feature 5307. Drawing.*

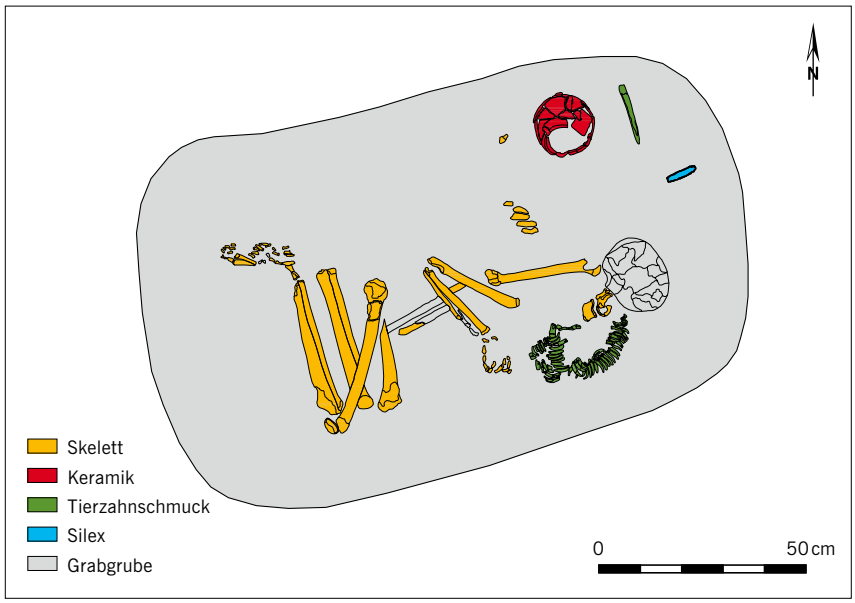
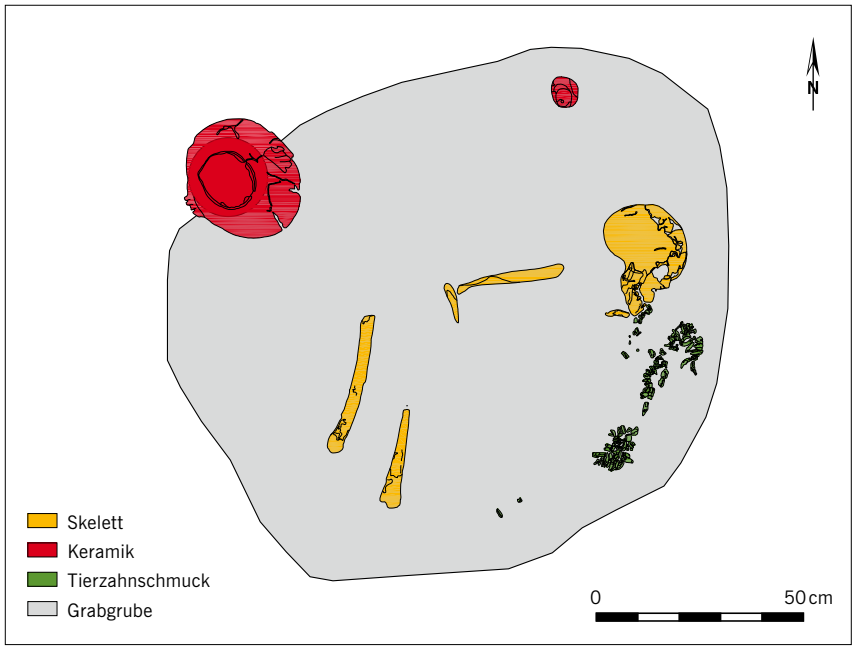



**Abb. 43** Profen, Bef. 7844. Umzeichnung.

***Fig. 43*** *Profen, feature 7844. Drawing.*



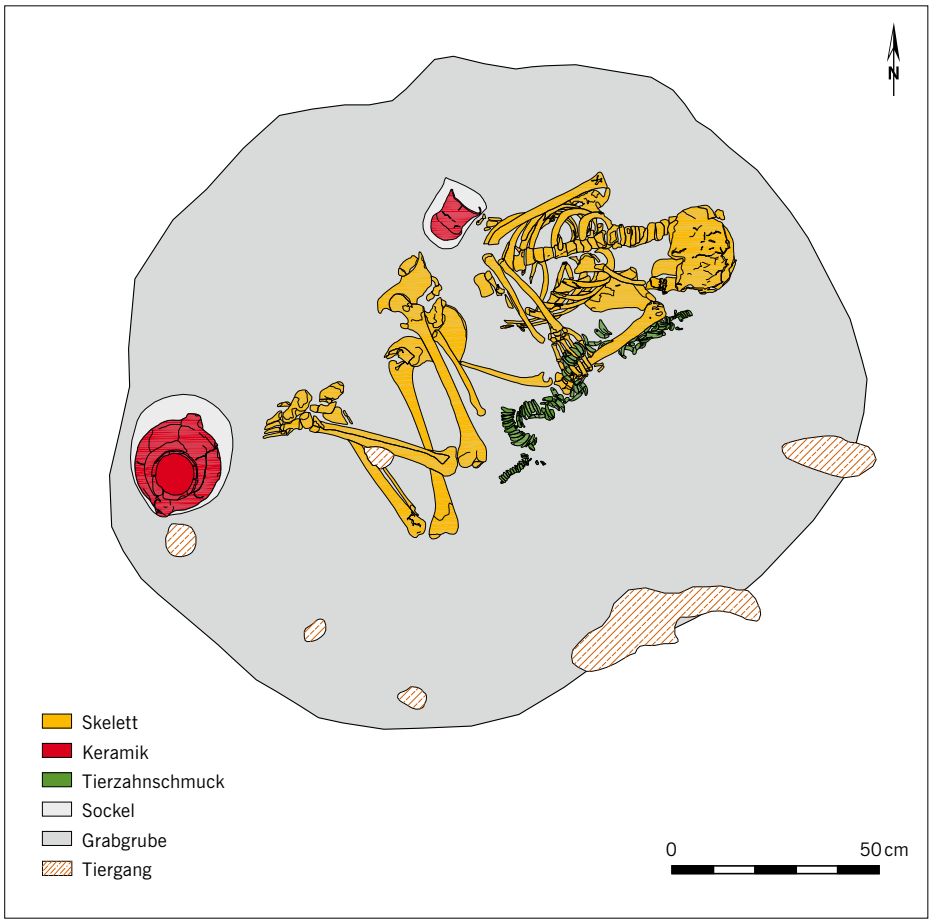



**Abb. 44** Profen, Bef. 7868. Umzeichnung.

***Fig. 44*** *Profen, feature 7868. Drawing*

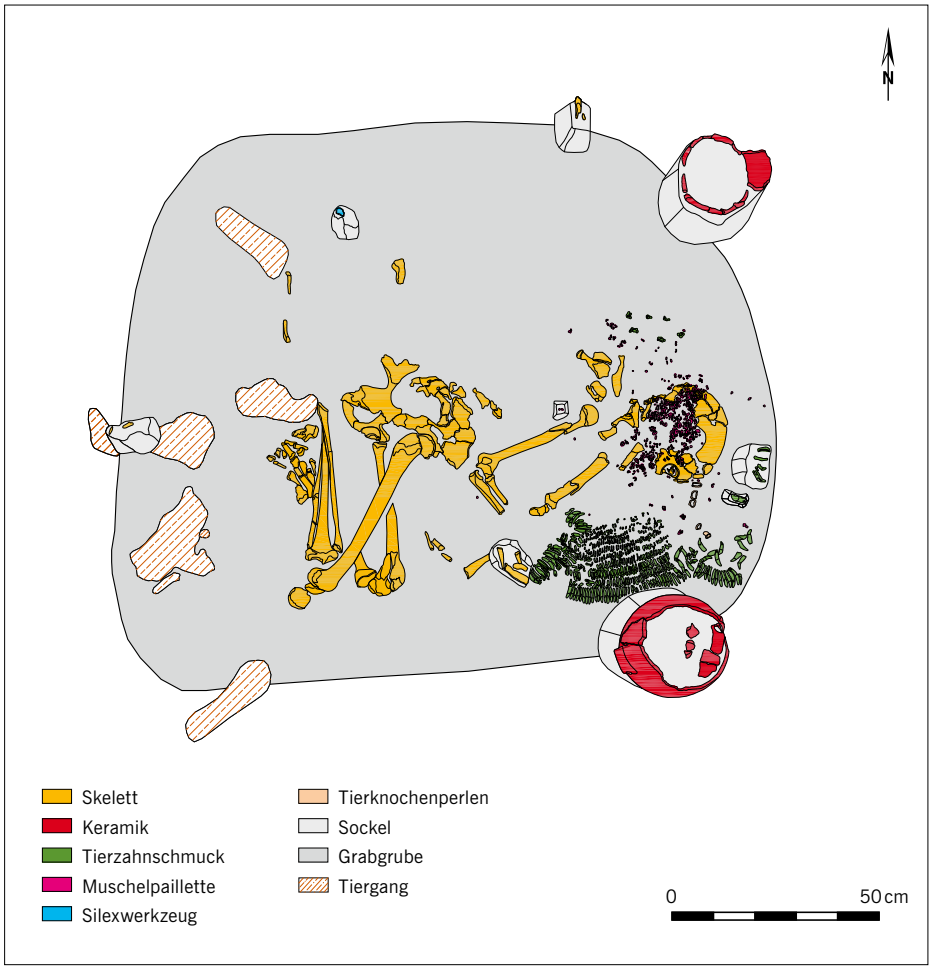



**Abb. 45** Profen, Bef. 8118. Umzeichnung (s. Abb. 6).

***Fig. 45*** *Profen, feature 8118. Drawing (see Fig. 6).*

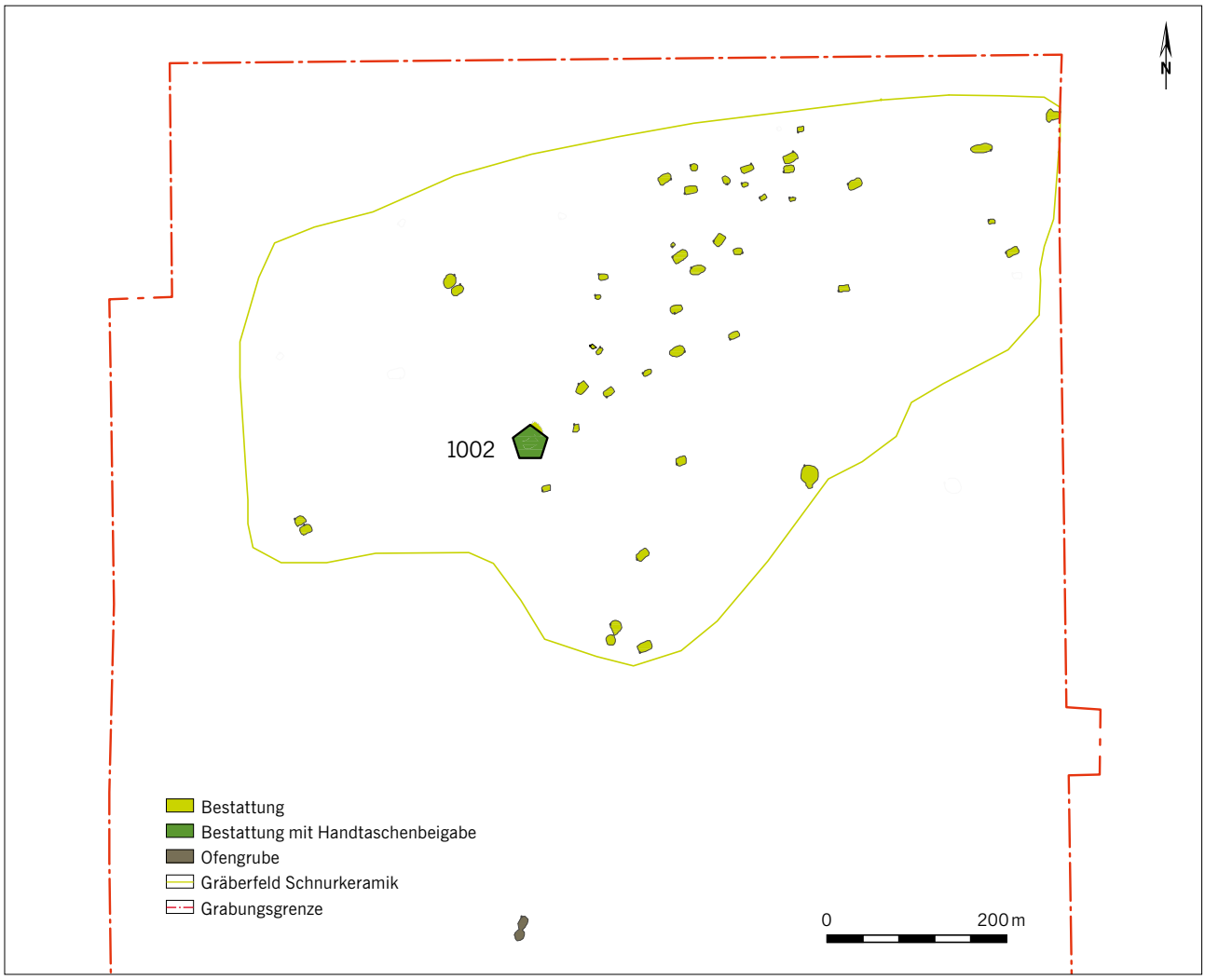



**Abb. 46** Rothenschirmbach, Lkr. Mansfeld-Südharz. Übersichtsplan, endneolithische Nutzungsphase.

***Fig. 46*** *Rothenschirmbach, Mansfeld-Südharz District. Site plan, Late Neolithic phase.*

## 6 Rothenschirmbach, Lkr. Mansfeld-Südharz

*Karin Schwerdtfeger, Emil Knapschinsky, Dominik Petzold, Susanne Friederich*

2025 fanden im Vorfeld einer Industrieansiedlung südlich der Ortslage Rothenschirmbach, Lkr. Mansfeld-Südharz, archäologische Untersuchungen statt[17]. In schnurkeramischer Zeit wurden zwischen zwei Höhenzügen nicht nur Ofenanlagen errichtet, vielmehr entstand auf einem ungefähr 90 x 90 m großen Areal eine kleine Nekropole, die auch von Leuten der Glockenbecherkultur genutzt worden war. Insgesamt 53 Körperbestattungen mit nachweislich 35 Individuen konnten erfasst werden (Abb. 46). Über die Hälfte der Toten gehört der schnurkeramischen Kultur an. Eine lineare Anordnung der Bestattungen deutet auf wegbegleitende Grabstellen hin, darunter auch eine mit Tierzahnapplikationen ausgestattete Frauenbestattung (Bef. 1002).

*Bef. 1002 (Abb. 47)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt; anthropologische Bestimmung: weiblich, spätadult bis frühmatur. Eine am Knochengerüst erkennbar Spondylosis zeigt schwere körperliche Arbeit an.

Neben zwei Bechern war der Verstorbenen entweder eine mit Tierzähnen gebordelte, zusammengefaltete Decke oder eine mit Tierzähnen applizierte Tasche mitgegeben worden. Vor dem linken Unterarm, der den Bauch der Verstorbenen umgriff, befindet sich eine längere und eine kürzere Reihe von durchlochten Tierzähnen bzw. Imitaten aus Knochen. Ein Muster kam durch die unterschiedliche Applizierung zustande: Bei der zum Körper gewandten Reihe weisen die Lochungen der Zähne nach innen und bei der anderen nach außen – dies könnte auch als Beleg eines einheitlich gefassten Stoffes angesehen werden; durch Zusammenfal-

17 1. Dokumentationsabschnitt 2024: Akt.-Nr. 17503, Grabungsleitung E. Knapschinsky. 2. Dokumentationsabschnitt 2024: Akt.-Nr. 18472, Grabungsleitung K. Schwerdtfeger, E. Knapschinsky.

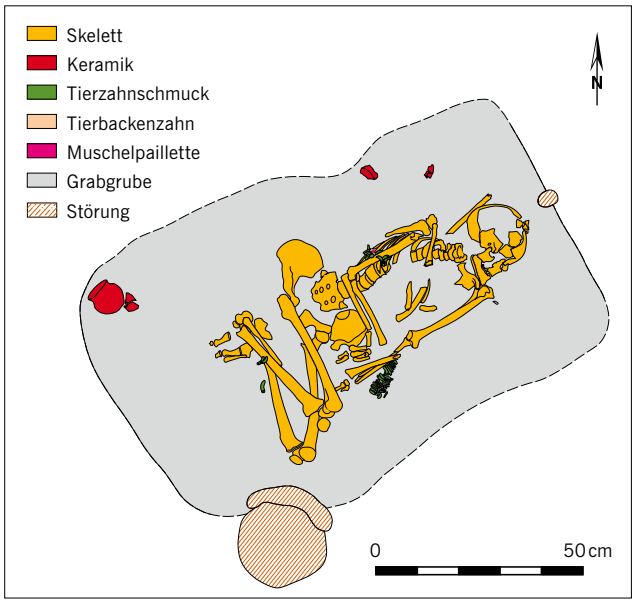



**Abb. 47** Rothenschirmbach, Bef. 1002. Umzeichnung.

***Fig. 47*** *Rothenschirmbach, feature 1002. Drawing.*

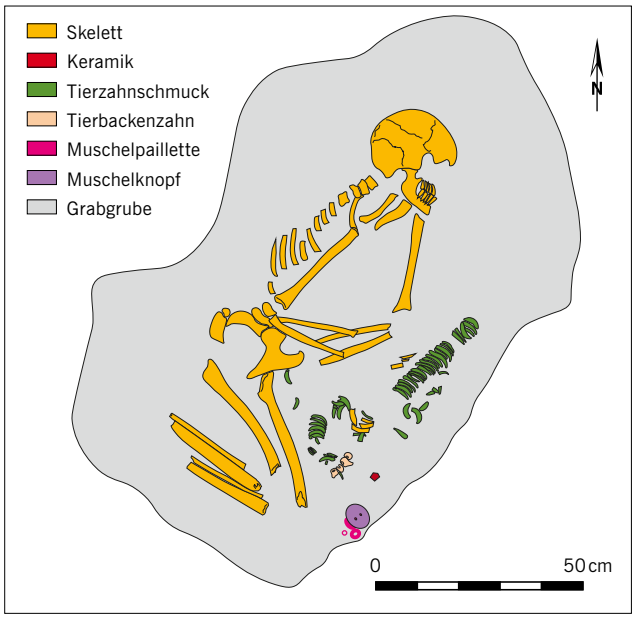



**Abb. 48** Wennungen, Saalekreis, Bef. 1003. Umzeichnung (s. Abb. 12).

***Fig. 48*** *Wennungen, Saalekreis District, feature 1003. Drawing (see Fig. 12).*

ten könnte das beschriebene Muster entstanden sein. Sechs durchlochte, aus Knochen nachgeahmte Zähne, kombiniert mit Muschelpailetten, dürften der Lage am rechten Oberarm nach zu urteilen das Gurtband verziert haben. Ob die im Beinbereich gefundenen 16 durchlochten Zahnimitate und sechs durchlochten Tierzähne ein Kleidungsstück schmückten oder den Saum einer Decke bildeten, kann nicht zweifelsfrei beantwortet werden.

Alle Zähne – Canini und Incisivi – stammen vom Hund. Den aus Tierknochen gefertigten Imitaten ist auch eine Hirschgrandel zuzufügen.

## 7 Wennungen/Wetzendorf, Saalekreis

*Susanne Friederich*

Im Vorfeld der ICE-Schnellbahntrasse Leipzig–Erfurt fanden umfangreiche Geländearbeiten statt[18]. Oberhalb eines linksseitigen Zubringers zur Unstrut kamen ungefähr 100 m nordwestlich von schnurkeramischen Gebäuden (Friederich 2019) knapp 75 der gleichen Kultur zugehörige Bestattungen zutage. Sie verteilen sich auf verschiedene kleinere Gräbergruppen.

### *Bef. 1003 (Abb. 48; s. Abb. 12)*

Nordost-Südwest orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt.

Die Tote könnte – auch wenn die Aussagekraft des Befundes aufgrund zahlreicher Nagetieraktivitäten stark eingeschränkt ist – auf einer mit mindestens 80 durchbohrten Tierzähnen eingefassten Decke gelegen haben oder bedeckt worden sein (Abb. 12). Die dachziegelartige Reihung der Zähne könnte allerdings auch als Applikation eines Gurtbandes gewertet werden (vgl. Profen Bef. 5307, s. Abb. 11).

### *Bef. 2110 (Abb. 49; s. Abb. 7–8; 13–14)*

Doppelbestattung; Individuum 1 (weiblich, 40–45 Jahre[19]) ist Nordost-Südwest orientiert als linksseitiger Hocker bestattet.

Vor dem Körper liegt eine mit apikal durchbohrten Hundezähnen bestickte Tasche: 260 Canini und Incisivi bilden die dachziegelartig übereinander gestaffelten Reihen. Am linken Abschluss schließen sich kleinere Eckzähne und aufgefädelte Muschelperlen an. Innerhalb des Tragebeutels befand sich der Körper eines neugeborenen Kindes, dessen Kopf, Arme und Beine aus diesem herausragten (s. Abb. 13). Die Hand der Frau ruhte auf dem Kopf des Kindes (s. Abb. 14). Über der Tasche liegt ein Stoff, angezeigt durch ca. 300 Muschelpailletten und einen mit mindestens sechs großen Hundemolaren gebordelten Saum. Zumindest die Kinderbeinchen dürften von diesem Tuch geschützt worden sein.

18 Akt.-Nr. 2365; Gesamtprojektleitung M. Becker.

19 Anthropologische Bestimmung J. Orschiedt, LDA.

**Abb. 49** Wennungen, Bef. 2110. Umzeichnung (s. Abb. 7–8; 13–14).

***Fig. 49*** *Wennungen, feature 2110. Drawing (see Fig. 7–8; 13–14).*

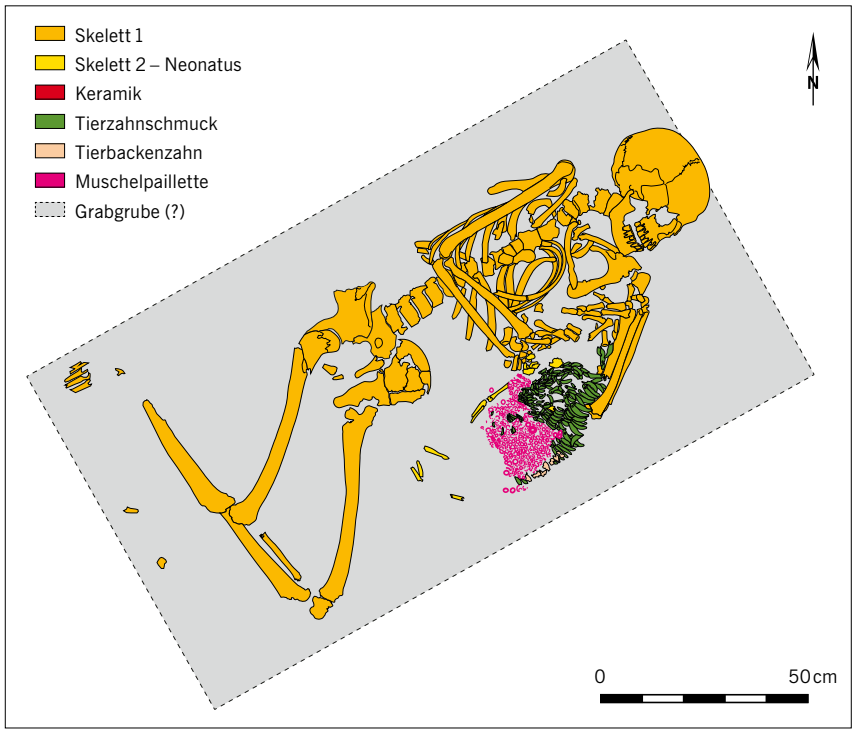



**Abb. 50** Wennungen, Bef. 5036. Umzeichnung.

***Fig. 50*** *Wennungen, feature 5036. Drawing.*

*Bef. 5036 (Abb. 50)*

Doppelbestattung; Individuum 1 (weiblich, matur) ist Nordost-Südwest orientiert als linksseitiger Hocker bestattet. Bei der anthropologischen Bestimmung wurde der Femur eines Kindes erkannt.

Oberhalb des Hinterkopfes befindet sich ein 5 x 5 cm großes Ensemble aus parallel zueinander ausgerichteten Knochenstäbchen von 2–12 cm Länge. Im näheren Umfeld lagen zahlreiche durchbohrte Hundeeckzähne. Möglicherweise gehören die Funde zu einem Trageobjekt, vergleichbar zu den in Profen und Karsdorf skizzierten ›Rucksäcken‹ (vgl. Fröhlich/Kegler 2012).

## 8 Helbra, Lkr. Mansfeld-Südharz

*Susanne Friederich, Ines Vahlhaus*

*Bef. 1 (Abb. 51)*

Ost-West orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt (Akt.-Nr. 3259).

Vor dem Oberkörper Hinweise auf eine mit möglicherweise in drei aus Tierzähnen aufgebauten Reihen bestickte Tasche (Hundezähne, teilweise aus Tierknochen geschnitzte Imitate; vgl. Vahlhaus in Vorb.)

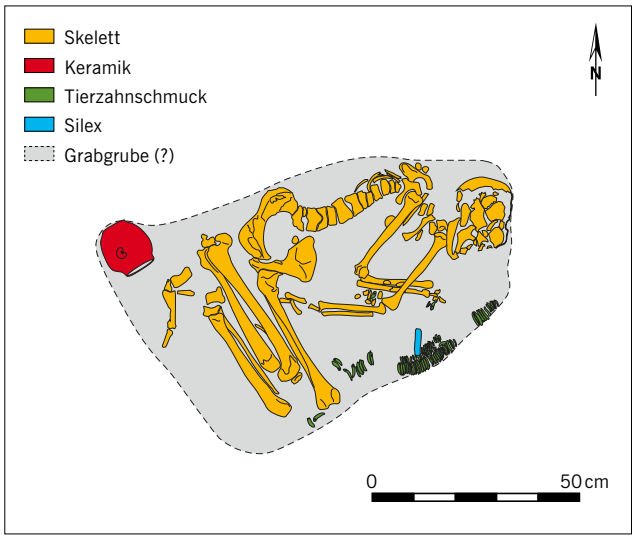



**Abb. 51** Helbra, Lkr. Mansfeld-Südharz, Bef. 1. Umzeichnung.

***Fig. 51*** *Helbra, Mansfeld-Südharz District, feature 1. Drawing.*

*Bef. 33*

Ost-West orientierte Bestattung, als linksseitiger Hocker mit Blick nach Süden niedergelegt.

Bei der Geländearbeit zeichnete sich – vor dem Oberkörper liegend – eine Vielzahl von Zähnen ab. Dieser Teilbereich mit dicht gereihten, dachziegelartig angeordneten Tierzähnen wurde als Teilblock geborgen (s. Abb. 10). Die vor dem Oberkörper deponierte Tasche war, orientiert an den Tierzähnen, mind. 20 × 15 cm groß; acht Reihen sind erhalten. Oberhalb des Knies zeichnet sich ein aus Hundeeckzähnen aufgebautes Gurtband ab (vgl. Vahlhaus in Vorb.).

## Nachtrag

Zum Zeitpunkt der Endredaktion werden bei bei Krauschwitz, Nessa und Aupitz, alle Burgenlandkreis, weibliche schnurkeramische Bestattungen mit Belegen für Taschen – teilweise Doppelbestattung mit Kleinstkind – freigelegt[20].

20 Akt.-Nr. 18770 Krauschwitz, Akt.-Nr. 18766 Nessa, Akt.-Nr. 19032 Aupitz.

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# Egalitarian or transegalitarian? A socioeconomic perspective on status and prestige during the Magdalenian and the Mesolithic

Thorsten Uthmeier

**Zusammenfassung**

Egalitär oder transegalitär? Status und Prestige während des Magdaléniens und Mesolithikums aus einer sozioökonomischen Perspektive

*Der vorliegende Artikel beleuchtet den Status und das Prestige sozialer Positionen unter prähistorischen Jägern und Sammlern anhand von Datensätzen aus dem französischen Magdalénien und Mesolithikum als diachrone Fallstudie. Unter Rückgriff auf klassische theoretische Ansätze aus den Sozialwissenschaften werden die Entstehung und normative Bestätigung von Prestige und Status als komplexes, multifaktorielles soziales Phänomen verstanden. Unter Berücksichtigung der vielen Einschränkungen, die sich aus den* per se *fragmentarischen archäologischen Überlieferungen ergeben, wird ein sozioökonomischer Ansatz angewandt, um gut erhaltene Körperbestattungen von Einzelpersonen zu bewerten. Auf der Grundlage eines neu entwickelten Bewertungssystems ergab die Auswertung der beiden Datensätze, dass die Gruppen im Magdalénien egalitär organisiert waren, während die gesellschaftliche Hierarchie im Mesolithikum stärker ausgeprägt war. Überraschenderweise haben ältere und senile Individuen in der Regel niedrigere Punktzahlen, was auf einen Verlust wirtschaftlicher Privilegien in Phasen reduzierter sozialer Aktivität gegen Ende ihres Lebens hindeutet. Wertvolle Kleidung, die sozioökonomisch an den am Körper befestigten Schmuckgegenständen gemessen wird, ist ein wichtiger Faktor für die Anhäufung von außergewöhnlich hohen Punktzahlen in einigen der Bestattungen von adulten Erwachsenen sowohl im Magdalénien als auch im Mesolithikum. Dieser Befund wird zwar durch die geringe Fallzahl abgeschwächt, aber er wird als Übertragung von Kleidung zwischen den Generationen interpretiert, die nur im Falle des Todes des eigentlichen Inhabers der entsprechenden sozialen Position unterbrochen wird. Trotz der Unterschiede bei den allgemeinen Investitionen in den Bau von Gräbern war der wirtschaftliche Wert der Bestattungen in beiden Perioden meist verborgen, sobald die Bestattungszeremonie beendet war.*

**Schlagwörter** Magdalénien, Mesolithikum, Frankreich, Primärbestattungen, Bewertungsschema

**Summary**

*The present article elucidates the status and prestige of social positions among prehistoric hunter-gatherers using datasets from the French Magdalenian and Mesolithic as a diachronic case study. Taking advantage of classic theoretical approaches from social sciences, the emergence and normative validation of prestige and status are understood as a complex, multifactorial social phenomenon. Considering the many constraints resulting from the* per se *fragmentary archaeological record, a socioeconomic approach is applied to evaluate well-preserved inhumation burials of single individuals. Based on a newly developed scoring system, the evaluation of the two datasets revealed that Magdalenian groups had an egalitarian societal organisation, whereas in the Mesolithic, societal hierarchy was more elaborated. Surprisingly, mature and senile individuals generally have lower scores, indicating a loss of economic privileges in phases of reduced social activity towards the end of their lives. Valuable clothing, socioeconomically measured by pendants attached as personal ornaments to the body or garment, is one major factor in the accumulation of exceptionally high scores in some of the burials of adults in both the Magdalenian and the Mesolithic periods. This finding, although weakened by the low number of cases, is interpreted as a transfer of clothing between generations, only interrupted in the case of the death of the actual holder of the related social position. Despite differences in the general investment in burial construction, in both periods the economic value of burials was mostly hidden once the burial ceremony had ended.*

**Keywords** Magdalenian, Mesolithic, France, primary inhumations, scoring system

## Introduction

The question of social organisation is central to all anthropological sciences. Whereas grand theories (see Münch 2002a) often refer to social organisation on the macroscale level, it is primarily the social microscale where social phenomena emerge. Individuals experience societal imprinting from early childhood onwards, being embedded in social networks and confronted with constant decision-making due to the dynamics and mostly open character of social

situations. As soon as marked differences in the rating of social positions occur and the number of higher-ranked positions is smaller than the number of applicants, social hierarchies emerge.

In prehistoric archaeology, it has often been assumed that social inequality is linked to the production of surplus and territoriality (e.g. Hayden/Guy 2024) and that it, therefore, predominantly occurs in sedentary societies. However, differences in the rating of social positions are omnipresent in all societies, starting with the differential rating of age class, gender, and skills or experience. Things are further complicated by the fact that the rating not only takes into consideration the ascribed value of a structural social position, often referred to as status, but at the same time also considers the rating of the behaviour of an individual who holds a social position. The concept of social role is one way to better understand the complex interplay of norms, societal expectations, and the rating of others that result in the potentially dynamic status and prestige of social positions. In this article, classic social sciences approaches are used as a frame of reference for investigating potential social inequality among prehistoric hunter-gatherers. In contrast to metadata, this study is based on the investigation of primary inhumations from burials of the French Magdalenian and Mesolithic. In addition, the burial of Bad Dürrenberg, Saalekreis District, Germany, is included to cover the full range of Mesolithic burial equipment and layout. The advantage of a direct correlation between the evident structure and the material culture of a burial on the one hand and the buried individual on the other is essential for the analysis of status and prestige, but to some extent, outbalanced by the small number of cases available. A major methodological problem lies in the reduced character of archaeological material data and the total lack of an emic perspective. This leads to a unidimensional operationalisation of the research question, which is merely based on an etic rating of economic aspects of the archaeological data from burials. Before elaborating on the material analysed and the methods used, the theoretical frame of the analysis is presented below.

## Status and prestige in the archaeology of prehistoric hunter-gatherers

In the light of ethnographic studies, the common notion that the social organisation of prehistoric hunter-gatherers can be considered less complex has been proven wrong due to two major observations (for an overview, see Moreau 2020):

First, the impression that egalitarian groups (Peoples/Bailey 2009, 285–286) lack any societal differences is incorrect. Instead, the views of other group members of a given individual usually differ due to gender and age, as well as family and ritual relationships (Haller 2005, 179), resulting in varying obligations, duties, and/or privileges. In addition, most hunter-gatherer groups have informal leaders who – in particular situations – have respected influence on group decisions, but no authority.

Second, while an egalitarian organisation in the above sense is often taken as the null hypothesis for most Palaeolithic and Mesolithic hunter-gatherers, there are constant claims that at least some Upper Palaeolithic hunter-gatherers may have been complex hunter-gatherers with transegalitarian organisation e.g.[1]. The main argument for equating groups of the Gravettian *sensu lato* (for a critical assessment of the status of this industry, see Pesesse 2017) and the Magdalenian with American Northwestern hunter-gatherers is their assumed availability of large amounts of storable food resources.

## Structural inequality in Magdalenian and Mesolithic hunter-gatherer societies of Central Europe? Formulating the null hypothesis

The second aspect mentioned in the section above, e.g. the hypothesis of Upper Palaeolithic transegalitarian hunter-gatherer societies, is of special interest here, as it explicitly refers to differences in status and prestige resulting from structural inequalities. But how probable is the existence of non-egalitarian social structures in the Magdalenian and Mesolithic? Table 1 shows feature characteristics from B. Hayden´s (2021) models for simple and transegalitarian hunter gatherers applied to the case studies of this article, e.g. the Magdalenian and Mesolithic in Central Europe. In the following, each variable with data available in the archaeological record is briefly discussed.

### *Richness of resources*

Regarding the richness of resources, any direct comparison of Pleistocene conditions with extant ecozones is complicated by the fact that despite comparable temperatures, marked differences exist – among other things – regarding insulation, rainfall, and snow cover due to the mid-latitude position of Central Europe. In the Early and Middle Magdalenian, cool temperatures and almost treeless landscapes are, to some extent, compensated by a vegetation mosaic and high ungulate biomass. Despite a marked seasonality in the availability of key resources and their dispersed spatial and temporal allocation (Schultz 2016, 104–106), there are still some good reasons to assess the availability of resources during the Magdalenian as ›rich‹. This is reflected in data from present-day boreal tundra ecosystems, in which herbivorous mammals consume up to 10 % of the net primary plant biomass (Schultz 2016, 106). During the Mesolithic, under interglacial conditions with a dense wood cover, resources are generally more evenly distributed and include far more edible plants. At the same time, the overall ungulate biomass is more diverse but lower if compared to boreal ecosystems. The low carrying capacities of densely

1 E.g. Hayden 2018; Hayden 2021; Uthmeier 2023; Hayden/Guy 2024.

| | Simple hunter-gatherers foragers | Complex hunter-gatherers, trans-egalitarian hunter-gatherers | Magdalenian | Mesolithic |
|---|---|---|---|---|
| Availability of resources | resource-poor | resource-rich | | |
| Diversity of technologies | limited | high | | |
| Demography | < 0.2 people per km² | > 0.2 people per km² | | |
| (Residential) mobility | high | low (seasonally sedentary) | | |
| Group size | small (< 20 people per group) | large (> 20 people per group) | | |
| (Food) sharing | mandatory | reduced | ? | ? |
| Production of surplus | storage for bad season | common | * | * |
| Competition involving food | forbidden | common (feasts, marriage, alliances) | ? | ? |
| Private property | limited | family and individual property | ** | ** |

**Tab. 1** Matrix of attributes for simple (in light orange) and complex (in green) hunter-gatherer groups (after Hayden 2021; * apart from caches, no storage constructions; ** indicated by the similar size of evident structures/dwellings and the gear therein).

***Tab. 1*** *Matrix der Attribute für einfache (in hellorange) und komplexe (in grün) Jäger- und Sammlergruppen (nach Hayden 2021; * abgesehen von Zwischenlagern, keine Lagerbauten; ** gekennzeichnet durch die ähnliche Größe der offensichtlichen Strukturen/Bestattungen und der darin enthaltenen Ausrüstung).*

forested Early Holocene environments in Central Europe are reflected in unexpectedly large annual territories for Mesolithic hunter-gatherer groups, deduced from raw material catchments (Richter 2023, 663–664). Consequently, the availability of resources during the Mesolithic is rated as ›rather poor‹.

### *Diversity of technologies*

Estimating the diversity of technologies is made difficult by the poor preservation of organic raw material. Judging from the available data, largely confined to objects made from stone or hard animal tissue such as ivory, antler, and bone, the diversity and internal variability of Magdalenian artefacts is large, especially if compared to the Mesolithic. Such an assumption is supported by comparative quantitative analysis of ethnographic data (Read 2008), showing that increased complexity of implements first and foremost relates to the number of residential moves and the risk of failure in the procurement of food resources. While residential mobility in Palaeolithic and Mesolithic archaeology can be inferred from raw material transportation distances, estimations of risk is more difficult to access (Collard et al. 2005). In essence, the risk of failure is assumed to depend on the seasonality of food procurement and the intensity of site use. Although these two factors do not necessarily correlate with specific climates in the ethnographic sample of the study cited above, they do correlate with broader subsistence tactics. In conclusion, ›more complex implement assemblages (including more elaborate implements) in groups with a collector strategy in comparison to a forager strategy also suggest that the former entails greater risk as a consequence of the greater resource intensification involved with a collector strategy‹ (Read 2008, 620).

### *Demography*

The most recent diachronic demographic estimations for the Upper Palaeolithic and Mesolithic based on a common methodological procedure are those using the Cologne protocol (Schmidt et al. 2021). Although not free from research and preservation biases, the datasets generally have proven reliable (Boemke et al. 2023). For Palaeolithic and Mesolithic hunter-gatherers, between 0.0004 and 0.02 individuals per square kilometre are calculated (Schmidt et al. 2020, 7 Fig. 1), which is lower by far than the numbers assumed by B. Hayden (2021) for transegalitarian groups, i.e. > 0.2 individuals per km² (Tab. 1).

### *(Residential) mobility*

Estimations of the amount of residential mobility in the Upper Palaeolithic are related to the duration of occupations at base camps. These approximations are made difficult by the possibility that a straightforward interpretation of complex evident structures as indicators of long-term occupations might be misleading because they may represent palimpsests from the re-use of more simple structures[2]. For the Central European Magdalenian, C. Pasda and M. Weiß (2020) suggest short-term occupations, whereas others argue for summer and winter camps probably maintained for a full season, or even for 'limited sedentism' (Jöris 2021, 329) of half-a-year or more. In the Mesolithic, the surprisingly complex evident features at the open-air site of Rottenburg-Sie-

2 E.g. Leesch/Bullinger 2012; Jöris 2021; Uthmeier 2021; Uthmeier et al. 2021.

benlinden, Tübingen District, Germany (Kind 2003), which can be best explained as dwellings used for a substantial period, challenge the widespread notion that Mesolithic occupations were generally short-term and that residential mobility during the Mesolithic was high. Nevertheless, estimations of Magdalenian and Mesolithic occupations longer than one season of a year must be seen critically and were most probably shorter than those documented for present-day transegalitarian hunter-gatherer groups. To conclude, it must be assumed that the Magdalenian and Mesolithic residential mobility was moderate to high.

#### *Group size*

The question of group size is equally related to the complicated question of the extent to which evident structures at a given site taken as dwellings are contemporaneous or not. Again, current debates are far from consensus and vary between a sequential use of neighbouring structures, as proven by refits of structural elements from fireplaces at Monruz-Champrevères, Canton of Neuchâtel, Switzerland (Leesch/Bullinger 2012), to the presence of central activity areas surrounded by between one (e.g. Bad Kösen-Lengefeld, Burgenlandkreis District, Germany: Uthmeier 2021; Uthmeier et al. 2021) and probably several light tent constructions (e.g. at Gönnersdorf, Neuwied District, Germany: Jöris 2021). Nonetheless, if each of the small tent-like dwellings of the Magdalenian and Mesolithic is equated with one core family, it is very unlikely that the overall group size exceeded 20 persons at the same time, even if a site was a seasonal meeting spot (e.g. Jöris 2021).

#### *Production of surplus*

In general, caches (for a definition see Uthmeier et al. 2020) in the Palaeolithic are rare. Whilst most of these contain artefacts deposited in preparation for planned or unforeseen future activities, some are discussed as meat caches (Einwögerer 2021; Chabai et al. 2022). However, apart from the difficulty of distinguishing between storage of staple food resources for times of nutritional shortage and the storage of surplus, the frequency and the sizes of Palaeolithic meat caches found so far speak for the former. To what extent meat was dried (for the interpretation of evident structures as smokers see Uthmeier 2021; Uthmeier et al. 2023) or stored underwater (Speth 2017; Fisher 2021) is unclear, as these techniques leave behind no or only diffuse archaeological traces (Fisher 2021). The hypothesis of social inequality based on these storable resources (e.g. Hayden/Guy 2024) is therefore not supported by data from the Palaeolithic period.

#### *Private property*

Private property is difficult to grasp in archaeological contexts. This also applies to the most convincing argument for grave goods in single burials, which seemingly indicate individual ownership. However, this notion might be misleading because any burial object could just as well be a gift donated after death. Nevertheless, it seems clear that the core and/or the extended family were the basic economic units, at least during the Magdalenian. This is suggested by the divergent origins of major raw materials found at the same site but in separated concentrations (e.g. at Gönnersdorf: Jöris et al. 2011), combined with the rather small sizes of the dwellings reconstructed so far (e.g. Leesch/Bullinger 2012). The most parsimonious explanation for these findings, which might be assigned to the Mesolithic site of Rottenburg-Siebenlinden as well, is the seasonal fission and fusion of family groups. If so, private ownership of gear would be inevitable on the family level, and personal property, in the light of the differences in age and gender among family members, highly probable. The hypothesis of private property in the Magdalenian (and the Mesolithic?) is further supported by the individuality of engraved and/or sculptured objects such as the famous Magdalenian spear throwers. Therefore, it can be concluded that most grave goods in Magdalenian and Mesolithic burials, and especially those attached to the body, such as pendants, were owned privately.

#### *Null hypothesis*

In sum, the existence of structural inequalities as the source of differential status and prestige in the Magdalenian and Mesolithic groups of Central Europe seems rather unlikely.

### Towards working definitions: social position, status and prestige in the social sciences

Status, prestige and prestige goods are often poorly defined in archaeological research, albeit that the assumed concept behind these terms, e.g. social inequality and its expression in material culture, is nevertheless widely applied (Bernbeck/Müller 1996). Referring to social science theory, R. Bernbeck and J. Müller (1996) distinguish between social position, status, and prestige. In the social sciences as well as in ethnology, social role is another key element that makes it possible to register the active part of social position, status, and prestige from a micro-scale perspective.

#### *Social position and status*

From a structural point of view, social positions are places in the societal scaffold independent from the personality of the actual holder but associated with socially defined patterns of expected behaviour and relations to other social positions (Merton 1996; Dahrendorf 2006; Schulz-Schaffer 2024). Rather than being fixed, social positions and the associated bundles of codes of conduct are created and transformed by the group members in the course of continuous discourse, as are the norms and values that are the baseline of these debates. The same applies to status as the result of the rating of a social position by the group. Differences in status are largely deduced from intersubjective dialogue and are, therefore, group-specific. It follows from its nature as a result of negotiation processes that the status of social positions is not necessarily static but may undergo changes. At the same time, especially in larger, more com-

plex societies, the rating of the status of a social position may vary among sub-groups, e.g. from a higher ranking in the peer group to a possibly lower ranking in socially more distant groups. In any case, social positions and their status are constitutive parts of the social structure independent of individuals who apply for them, and, to a large degree, independent of the personality of the individual who holds a certain social position.

#### *Social prestige*

In contrast to status, prestige depends on the personality of the position holder. Much like the social role, which is a metaphor for the expectations the group or society addresses to the holder of a social position and the resulting normative behavioural rules, prestige belongs to the active parts of social positions. The rating of prestige is coupled with the degree of fulfilment of expectations associated with a social position. In other words, the better the performance in terms of the expected behaviour, the higher the prestige. Following R. Bernbeck and J. Müller (1985), this concept of prestige goes back to M. Weber (1922 [1980]) and is embedded in his notion of social power. In Weber´s view, prestige may lead to authority based on the deliberate acceptance by other group members; the transfer of competence for decisions is voluntary. Prestige comprises objective and subjective aspects. The objective components are the visible and thus measurable consequences of prestige, e.g. more central positions in social networks, courteousness when meeting others, or – if this is congruent with the role expectations – the accumulation of wealth. The subjective aspect of prestige is the feeling of positive or negative feedback that subjectively originates from role behaviour and the self-assessment of the degree of prestige one has gained.

#### *Social role*

Social role is the bundle of expectations other group members direct towards the holder of a social position[3]. These expectations are expressed in a combination of norms and rules regarding how to perform. The degree of fulfilment largely influences the prestige rating of a position holder. At the same time, the manifold relations between the role holder and the others who interact with him or her, and the fact that any member of a society has more than one social position and thus performs several social roles creates considerable potential for role conflicts. Originally, social role was a microscale element of structural-functional approaches and was supposed to secure societal stability when an individual learned role expectations during socialisation. Such an inflexible interpretation of social role underwent substantial modification, stimulated – among other things – by the theory of symbolic interaction. The relation between the holder of a social position and the accepting but expecting – others is now seen as influenced by insecurity, empathy and a recurrent reciprocal discourse about performances of a given social role (Mead 1973; Blumer 2013, 94: ›taking the role of others‹; for an application in Palaeolithic archaeology see Uthmeier 2016). This not only includes changes in the rules and assessment of the prestige of a given social position by the group but at the same time may allow the actors of a social role to implement changes by themselves. The window of opportunities is limited by the amount of freedom the role expectations offer or the ability of the actor to enforce his or her perception of appropriate behaviour by using charisma, prestige obtained from other social positions, or inherited means of power. Both the precision of fit of the individual performance to the role expectations and the possible freedom to interpret a social role are not only a result of the flexibility of the underlying social norms and values but also of subjective knowledge. In more recent concepts that combine the two major models of social acting, e.g. *homo oeconomicus* and *homo sociologicus*, any social actor is a ›[...] resourceful, restricted, expecting, evaluating, maximising man‹ (Esser 1999, 235). It follows that the scale of innovation in the interpretation of a social role is not only a question of power and the result of evaluating the pros and cons of being innovative but also highly depends on the amount of information to which an individual has access.

## Material and Methods

### Methods

#### *Measuring status and prestige in social sciences and in archaeology*

In the social sciences, status is often measured by the formal education expected as suitable for candidates of a social position and the economic outcome after becoming the holder of that position (Wegener 1985). Recently, the subjective rating of the status by the position holder also gained importance (Pollack 2024). Because this relies primarily on individual performance, the two-fold nature of status as the result of both the rating of the entire group and the subjectively felt consequences of that ranking applies even more so to prestige. To register the objective framing of status and prestige, e.g. the rating by the group – or rather the society – and the subjective aspect of the self-evaluation of the holder of a position, B. Wegener (1985) suggests collecting data not only from the viewpoint of society but also of the individual, combined with measurements in different social scales. However, much of the data needed for such an approach stem from interviews, which are unavailable in prehistoric archaeology (Tab. 2). Therefore, the *per se* important differentiation between an objective and a subjective component of status and prestige must be left aside. Even more, although status and prestige are different dimensions of social position and not inter-communicable,

3 Merton 1996; Münch 2002b, 347–364; Dahrendorf 2006; Preyer 2012, 55–94; Schulz-Schaffer 2024.

| Social scale | | Attribute | Operationalisation and measurement | Measurement in Paleolithic and Mesolithic archaeology |
|---|---|---|---|---|
| Objective | societal | Social structure | Number of prestigious social positions and number of candidates for open positions (in case of official positions: metrical attributes) | Impossible due to the lack of graveyards, demographic census and written sources |
| Objective | individual | Social-economic wealth | Metrical attributes | Burial equipment, prestigious objects; only in cases when status and prestige correlate with economic wealth |
| Subjective | societal | Social interaction | Social network analysis based on participatory observation or interviews | Impossible due to the lack of objects indicative for exchange of goods (and information) in between individuals or groups that would allow proper network analysis |
| Subjective | individual | Social reputation | Interviews (reliance questionable due to subjectivity in the answers) | Impossible |

**Tab. 2** Scales and attributes of status and prestige as well as measurement instruments in social sciences (in grey, after Wegener 1985) and their practicability in Palaeolithic and Mesolithic archaeology.

***Tab. 2*** *Skalen und Attribute von Status und Prestige sowie Messinstrumente in den Sozialwissenschaften (in Grau, nach Wegener 1985) und ihre Anwendbarkeit in der paläolithischen und mesolithischen Archäologie.*

it seems impossible to differentiate them with the Palaeolithic and Mesolithic data at hand, which are not only fragmentary but at the same time reduced to an uninformed, etic perspective. The – to a certain degree disappointing – consequence is that the present study must fall back on structural-functionalist approaches to some extent by presuming socio-economic status to be the best measurement instrument to investigate differences in status and prestige in Palaeolithic and Mesolithic societies.

### *The economic and societal rating of objects: Practical and prestige technologies*

Although it would also be conceivable to investigate status and prestige on the level of settlements, any consideration of the societal evaluation of social positions must rely on burials. In fact, apart from the analysis of single artefacts or refits of production sequences correlated to the producer, burials are one of the few possibilities to link archaeological material culture to individuals. Even though, in the end, any aspect of a burial is, first and foremost, the materialised outcome of activities and decisions of the entombing community, it would be far-fetched to assume no relation at all between the buried individual and his or her burial features. This is not to say that status and prestige are necessarily reflected in burial equipment, but in cases where a group agrees on showing social differences in individually owned material culture, there is good reason to expect such an association in burial contexts. Based on these premises, scoring systems to collect data on the ›wealth‹ of burial equipment have already been applied to prehistoric cemeteries based on workload, diversity and variability of objects, number of objects, and the assumed value of certain raw materials (e.g. Rebay 2005; Rebay 2006; with a summary of the controversy about quantitative and qualitative approaches: Burmeister 2009). In economic approaches, the presence of ›prestige goods‹ or ›status symbols‹[4] e.g. is often supposed to indicate high status and prestige. Most working definitions name high workloads for their manufacture deduced from experimental archaeology, valuable raw material rated as such due to transportation distances, and workload calculated for its acquisition, and/or the import of objects from distant regions (Eggert 1991; Hayden 1998). In addition, rarity is often taken as another part of the working definitions. For hunter-gatherer contexts, B. Hayden (1998; Hayden 2021, 38–40), referring to ethnographic studies, distinguishes between practical technologies and prestige technologies. According to him, practical technologies solve practical problems using the most cost-efficient solution. In contrast to economical and effective practical technologies, prestige technologies solve social and political problems by adding effort and cost to the manufacture or procurement. The focus is not on cost-efficiency but on impressing viewers or increasing the magnitude of debt when an object is exchanged with others. Among hunter-gatherers, prestige technologies can occur as ritual items that are owned by the group, or as status items, which are individually owned capital for sociopolitical strategies benefitting the individual owner. Ritual items are usually hidden and rare, whereas prestige items are produced in greater numbers, and since their owners often compete, they are displayed in public. From a cultural anthropological point of view, prestige

4 E.g. Eggert 1991; Müller/Bernbeck 1996; Schumann 2012; Bagley/Schumann 2013.

| | Points (in ascending order from 0 to N within category) | Maximal total sub scores | |
|---|---|---|---|
| **Burial context** | 0 point = all-day conext (e.g. in the centre of activitiy area) | **3** | One entry only |
| | 1 point = in separate area within a campsite | | |
| | 2 points = special burial site, with several burials | | |
| | 3 points = isolated special burial site with single burial | | |
| **Burial orientation (one entry)** | 0 point= random (or unknown) | **2** | |
| | 1 point = along a given axis of the site | | |
| | 2 points = along compass point | | |
| **Burial construction (several entries possible)** | 0 point = on the ground level | **8** | In addition: multiple entries possible (accumulation of points) |
| | 1 point = in natural depression | | |
| | 2 points = in artificial pit | | |
| | 3 points = (additional) construction with material collected from the site (stone slabs) | | |
| | 4 points = (additional) construction with locally to regionally collected materials (pebbles from river terraces, faunal elements) | | |
| | 1 additional point = construction visible on the surface | | |
| **Burial equipment attached to the body (several entries possible)** | 1 additional point = ochre scatter | **28** | |
| | 0 point = no pendant | | |
| | 1 point = isolated pendant | | |
| | 2 points = numerous pendants | | |
| | 3 points = pendants attached to headgear or headdress | | |
| | 4 points = pendants attached to upper or lower part (clothes) | | |
| | 5 points = pendants attached to upper and lower part (clothes) | | |
| | 6 points = role attributes attached to the body used during lifetime (e.g. »mask«) | | |
| | 7 points = materials attached to the body pointing to differential treatment of the dead (e.g. plastered head etc.) | | |
| | 1 additional point = objects attached to the body were unused (made for the burial) | | |
| | 1 additional point = raw material of exceptional value (transportation distance/acquisition costs) | | |
| | 1 additional point = manufacture of exceptional value (work load) | | |
| **Burial equipment: grave goods (several entries possible)** | 0 point = no grave goods | **17** | |
| | 1 point = faunal remains (food offering) | | |
| | 2 points = all-day equipment from flaked industry | | |
| | 3 points = all-day simple objects produced from organic materials (bone point, smoothener, axe etc.) | | |
| | 4 points = complex objects produced from organic materials (spear thrower, perforated baton etc.) | | |
| | 5 points = role attributes (drumstick etc.) | | |
| | 1 additional point = raw material of exceptional value (transportation distance/acquisition costs) | | |
| | 1 additional point = manufacture of exceptional value (work load) | | |
| | **Maximal total score 1** | **58** | |
| | 1 additional point: body wrapped in leather? | **1** | |
| | **Maximal total score 2** | **117** | |

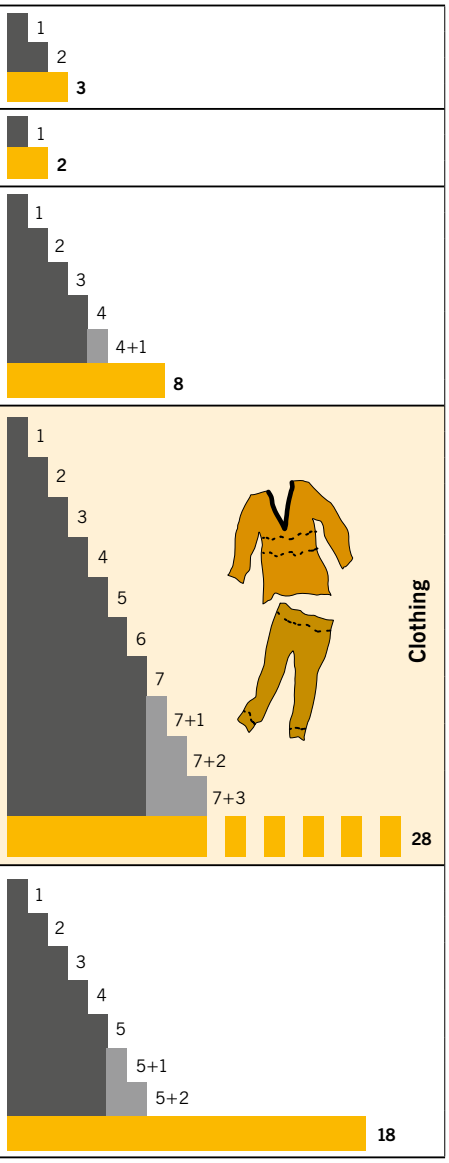


**Fig. 1** Scoring of different categories of burial equipment (table on the left) and maximal score per category (note that in several categories multiple entries are possible in case the listed items/objects are present; in these cases, the accumulated maximum score is given); green = low score; yellow = medium score; red = high score.

***Abb. 1*** *Bewertung der verschiedenen Kategorien von Grabausstattungen (Tabelle links) und maximale Punktzahl pro Kategorie (zu beachten wäre, dass in mehreren Kategorien Mehrfachnennungen möglich sind, falls die aufgeführten Gegenstände vorhanden sind; in diesen Fällen wird die kumulierte maximale Punktzahl angegeben); grün = niedrige Punktzahl; gelb = mittlere Punktzahl; rot = hohe Punktzahl.*

items transform a surplus of resources into durable objects that maintain the surplus value, create and maintain social bonds when given to others, visually underline the importance of key sociopolitical events, serve as compensation in social conflicts, and display general economic success and political power. However, if such far-reaching interpretations can be reliably made based on material culture alone seems questionable. Even more so, the actual prestigious value of an object in an unknown society is difficult to access and may not correlate with the effort made during the production (Kraußе 2006). The same applies to role attributes, e.g. objects visually identifying holders of specific social positions. Using B. Hayden´s (2021) terminology, role attributes are not necessarily part of ›prestige technologies‹. For example, the simple gear of a hunter or the percussion tools of a flintknapper almost certainly had the function of role attributes meaningful in specific societal situations. Of interest in this study are role attributes potentially connected to the higher prestige and status of the social position they visually indicate. Based on large-scale ethnographic studies, the probably most secure indication of role attributes in the archaeology of hunter-gatherers is

| Signifier | Social inequality | |
|---|---|---|
| | Present | Absent |
| **Overall value of burial** | Burials with higher total scores separated from all other burials by clear gaps | Continuum of burial scores |
| **Diversity of burial equipment** | Burials with high values show a larger variety of different object classes | Comparable diversity of burials goods in all burials |
| **Role attributes** | Burials with role attributes have higher total scores | Burials with role attributes do not have higher value scores |
| **Special treatment of the dead** | Some burials show structures visible on the surface | Burials structures are simple |

**Tab. 3** Matrix of attributes taken as indication for the presence or absence of social inequality in the present study.

***Tab. 3*** *Matrix der Attribute, die in der vorliegenden Studie als Indikator für das Vorhandensein oder Fehlen von sozialer Ungleichheit herangezogen wurden.*

their association with ritual technologies. In the archaeology of hunter-gatherers, this primarily applies to masks and noise-making equipment supposedly used by shamans (VanPool 2009; Uthmeier 2018).

*The measurement of grave equipment in this study*

The assessment of the data collected is designed for comparative analysis within and between the Magdalenian and Mesolithic. Objects of grave equipment are rated solely by their estimated workload; their normative value is not measured. Workloads are estimated within predefined categories and, within these categories, only in relation to each other in a simple ranking order with equal intervals and without correspondence to actual worktimes (Fig. 1). For example, within the category of ›burial equipment attached to the body‹, which by and large corresponds to clothing, isolated pedants have a lower score than numerous pendants, which again have a lower score than pendants clustering near the upper and/or the lower body part of the body. The rationale behind the higher scores of clustered pendants is the assumption that they indicate the presence of more elaborate clothing, such as parkas and/or trousers. Potential ›prestige technology‹, e.g. higher transportation and acquisition costs deduced from exogenous or rare raw materials, as well as the presence of elaborate manufacturing procedures, are rated by their extra workload with one additional point. The lack of further differentiation takes into consideration the problems in locating raw material sources and estimating exact workloads. Notable exceptions are role attributes: in this study antler masks (if present, rated with an addition of 6 points) and the evidence for special treatment of the dead (if present, rated with an addition of 7 points). The latter is deduced from a rare and, at the same time, elaborate staging of the burial. The only example from this study's dataset is from Bad Dürrenberg, where the corpse of an adult woman holding an infant was placed in a sitting position in a large basket-like structure (Orschiedt et al. 2023). One problem in the proposed operationalisation of economic status lies in the different resolution within the categories, coupled with a simple ranking order of point scores. Because more parameters result in higher parameter values within a category, the maximal possible scores of the proposed categories differ substantially. If all parameters are present, burial equipment attached to the body reaches the highest potential maximum score (28 points) – higher than burial goods (18 points) and much higher than burial construction (8 points), burial orientation (2 points) or burial context (3 points). Quantitative analysis is done by the comparison of scores in histograms produced for the maximum scores of the burials, the average scores of each category, and scores differentiated by gender and age. Age classes are defined as infans I (0–6 years), infans II (7–12 years), juvenile (13–18 years), adult (19–40 years), mature (41–60 years) and senile (> 60 years), respectively. Any interpretation of age class distributions must take into consideration that the time spans represented differ substantially due to the anthropological resolution of the respective skeletal material: while the range of infans I, infans II, and juvenile is six years, the classes of adults, mature and senile have a range of 20 years or more.

*Testable attributes of potential inequality in the Upper Palaeolithic and Mesolithic*

Some basic assumptions are necessary when methodologically linking status and prestige with economic status. In the present study, it is inferred that holders of social positions with higher status and prestige

a) play more prominent roles in negotiation processes and decision-making due to (situational) authority,
b) occupy more central positions in social networks,
c) have more social contacts within their own group and with members of other groups, and
d) have more chances to be equipped with role attributes indicating specific positions.

If these prerequisites hold true, individuals with a higher status and prestige are expected to have greater chances of receiving more

a) valuable (including far-travelled) objects from balanced reciprocal exchange,

b) valuable objects as gifts,
c) valuable objects as role attributes, and
d) elaborate burial constructions and burial equipment resulting from the involvement of larger parts of the social network.

As a matter of course, these attributes are neither exclusive nor are all of them mandatory at the same time. It must be underlined that the correlation between status and prestige of social positions and valuable objects is only possible for societies that allow differences in personal ownership and, at the same time, award higher status and prestige with material culture. Societies with different attitudes towards the material reward for societal performance or social positions not awarded in economic ways traceable in archaeology cannot be analysed in this way. For the sake of methodological traceability, a matrix is used for the interpretation and discussion of the scores (Tab. 3).

## Material

A brief survey of the literature found that the number of completely preserved Magdalenian inhumation graves is surprisingly low[5]. The criterion of complete preservation necessary to correlate potential grave goods with the buried individuals leads to the exclusion of more recent discoveries of human remains from Magdalenian contexts, such as the perinatal human skeleton found in an ice wedge at Wilczyce, Świętokrzyskie Voivodeship, Poland (Irish et al. 2008) or the remains of a burial from the El Mirón Cave, Autonomous Province of Cantabria, Spain, which underwent severe post-depositional alteration by both animal and human agency, leaving behind only minimal traces of the original context (Marín-Arroyo 2015). If a critical evaluation of data (as much as possible) is another criterion, then the number does not exceed the nine burials already extensively described and analysed by B. Wüller (1999). Consequently, the latter monograph is the major source for the data acquisition of Magdalenian burials (Tab. 4). The fact that all the better-preserved burials of the Magdalenian that allow a rating of the complete burial equipment come from France sets the geographical frame for the Mesolithic, which is known for much larger numbers of burials preserved (e.g. Grünberg 2000; Meiklejohn et al. 2016; Boulestin 2018). To keep the data comparable, only inhumation graves from Mesolithic groups in France using terrestrial subsistence strategies were included in the analysis, which therefore excludes larger multi-burial cemeteries from semi-sedentary societies in Brittany economically related to ›harvesting the sea‹ (Dupont et al. 2009; Larsson 2016). The strict application of these criteria resulted in a total of nine Mesolithic burials (Tab. 5), for which data was extracted from J. M. Grünberg (2000). To also cover burials with extremely elaborate burial equipment, the site of Bad Dürrenberg[6] was included in the Mesolithic dataset as well. For the sake of simple reasoning, e.g. following the principle of Ockham´s razor (Lazar 2010), it is assumed that at Bad Dürrenberg the bulk of burial equipment was dedicated to the adult female (in this study labelled ›Bad Dürrenberg 1‹) and not the 6- to 8-month-old boy (for determinations of age and gender see Orschiedt et al. 2023). Regarding the scoring of individual burial equipment, the infant (›Bad Dürrenberg 2‹) only profits from the rating of the burial context, the burial orientation and the burial construction. Such scoring seems acceptable because even if the burial construction was, in the first case, devoted to the commemoration of the adult, it was nonetheless a decision of the burying community to entomb the newborn in the same grave. This is particularly comprehensible when presuming a close genetic and/or societal relation between the two individuals: in the light of genetic analysis (Orschiedt et al. 2023), the female and the boy were either directly related no closer than the 4$^{th}$ degree or as close in time as four to five generations. The low overall number of cases and the many burials excavated before WW II in each subset of data immediately lead to the question of representativity. A superficial exploration of this aspect (Tab. 6) underlines that the dataset is indeed debited by biases. The most important one is the paucity of burials. Despite comparably low estimations of the total populations for both the Magdalenian and the Mesolithic (Schmidt et al. 2020, 7 Fig. 1) and an estimated meta-population for the Magdalenian of between 4900 and 10 700 individuals only (Kretschmer 2015; Maier 2017), there is still a substantial general imbalance between the demographic estimates and the preserved and/or excavated burials (see also: Jeunesse 2021). There is no question that preservation and yet undiscovered sites are in part responsible for this bias. However, the overall 1570 Magdalenian sites used by I. Kretschmer (2015) for her demographic estimates seem representative enough to support the hypothesis of selective burial rituals, which is reinforced by the occurrence of secondary burials (i.e. in the Magdalenian of the Brillenhöhle, Alb-Donau District, Germany: Orschiedt 1999) and the burial of selected body parts (i.e. the Mesolithic burials in the Ofnet Caves, Donau-Ries District, Germany: Orschiedt 2002). Both examples point to primary burial rituals conducted outside the campsites, possibly without leaving any archaeological traces. It follows that being buried in larger campsites might have already been a privilege (see Jeunesse 2021). In general, this also applies to Mesolithic groups, although the number of sites is much larger than in the Magdalenian (Meiklejohn et al. 2016). Among these, some sites have the character of linear cemeteries with continuous use over several generations, but this seems to be linked to aquatic or marine resources (Meiklejohn et al. 2016, 33). If so, the dataset analysed in this study would primarily record individuals selected for burial immediately on the campsites, possibly already indicating higher status and prestige.

5 E.g. Binant 1991a; Binant 1991b; Henry-Gambier 2018; Orschiedt 1999; Orschiedt 2013; Orschiedt 2018; Wüller 1999.

6 Geupel 1977; Porr 2004; Porr/Alt 2006; Orschiedt et al. 2023.

| | Number of data set | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Site** | **Abri Corneille-Sulauze I - 1** | **Abri Corneille-Sulauze I - 2** | **Abri Corneille-Sulauze I - 3** | **La Baume de Montclus - 1** | **La Baume de Montclus - 2** | **Le Cuzoul de Garmat** | **Le Poeymaü** | **Le Rastel** | **Abri Sous-Balme** | **Bad Dürrenberg - 1** | **Bad Dürrenberg - 2** | **occurences** |
| »Meta« data | site type | rock shelter | | | rock shelter | | cave | cave | cave | rock shelter | open air | | |
| | excavation date(s) | 1947–1977 | | | 1954–1971 | | 1923–1933 | 1948 | 1961 | 1957 | 1934/2019 | | |
| | stratigraphical position | layer 6, base | | | layer 5, base | layer 16 | layer II | layer 3 | layer 5 | niveau 1 | 1 layer | | |
| | industry | Montadien ancien | | | Epi-Castel-novien | Sauveterrien final | | Late Mesolithic | Mesolithic | | | | |
| | number of burials in the site | 3 | | | m n 2 | | 1 | 1 | 1 | 1 | 2 | | **11** |
| | number of dead in the same burial | 2 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | | **11** |
| Individual: body position | supine position | | | | | | | | | | | 1 | **3** |
| | flexed position | | 1 | | 1 | | | | | 1 | | | **3** |
| | contracted position (taphomy or wrapping?) | | | | | | | | 1 | | | | **1** |
| | sitting upright position | | | | | | | | | | 1 | | **1** |
| | unknown position | 1 | | 1 | | 1 | | | | | | | **3** |
| Individual: anthropology | infans I (0–6 years) | | | | | | | | | | | 1 | **1** |
| | infans II (7–12 years) | | | | | | | | | | | | **0** |
| | juvenile (13–18 years) | | | | 1 | | | 1 | | | | | **2** |
| | adult (19–40 years) | | 1 | | | | 1 | | 1 | 1 | 1 | | **5** |
| | matur (40–60 years) | | | | | | | | | | | | **0** |
| | senile (< 60 years) | 1 | | 1 | | | | | | | | | **2** |
| | age unknown | | | | | 1 | | | | | | | **1** |
| | gender female | | | 1 | 1 | | | | | | 1 | | **3** |
| | gender male | | 1 | | | 1 | 1 | 1 | 1 | 1 | | | **6** |
| | gender unknown | 1 | | | | | | | | | | 1 | **2** |
| | anthropological specifics | | | | | | | | | | | | |
| Burial context | 0 point = all-day conext (e.g. in the centre of activitiy area) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | **8** |
| | 1 point = in separate area within a campsite | | | | | | | | | | | | **0** |
| | 2 points = special burial site, with several burials | | | | | | | | | | | | **0** |
| | 3 points = isolated special burial site with single burial | | | | | | | | | 3 | 3 | 3 | **3** |
| Burial orientation (one entry) | 0 point= random (or unknown) | | | 1 | | 1 | | | | | | | **2** |
| | 1 point = along a given axis of the site | 1 | 1 | | 1 | | 1 | | | 1 | | 1 | **6** |
| | 2 points = along compass point | | | | | | | 2 | 2 | | 2 | | **3** |
| Burial construction (several entries possible) | 0 point = on the ground level | | | 1 | | 1 | | | | | | | **2** |
| | 1 point = in natural depression | | | | | | | | | | | | **0** |
| | 2 points = in artificial pit | 2 | 2 | | 2 | | 2 | 2 | 2 | 2 | 2 | 2 | **9** |
| | 3 points = (additional) constrcution with material collected from the site (stone slabs) | 3 | 3 | | 3 | | 3 | 3 | 3 | 3 | | | **7** |
| | 4 points = (additional) construction with locally to regionally collected materials (pebbles from river terraces, faunal elements) | | | | | | | | | | 4 | 4 | **2** |
| | 1 additional point = construction visible on the surface | | | | | | | 1 | | 1 | 1 | 1 | **4** |
| | 1 additional point = ochre scatter | | | | | | | | 1 | 1 | 1 | 1 | **4** |
| Burial equipment attached to the body (several entries possible) | 0 point = no pendant | 1 | 1 | 1 | 1 | 1 | | 1 | | | | 1 | **7** |
| | 1 point = isolated pendant | | | | | | 1 | | 1 | | | | **2** |
| | 2 points = numerous pendants | | | | | | | | | | 2 | | **1** |
| | 3 points = pendants attached to headgear or headdress | | | | | | | | | 3 | | | **1** |
| | 4 points = pendants attached to upper or lower part (clothes) | | | | | | | | | | | | **1** |
| | 5 points = pendants attached to upper and lower part (clothes) | | | | | | | | | | | | **0** |
| | 6 points = role attributes attached to the body used during lifetime (e.g. »mask«) | | | | | | | | | | | | **0** |
| | 7 points = materials attached to the body pointing to differential treatment of the dead (e.g. plastered head etc.) | | | | | | | | | | 7 | | **1** |
| | 1 additional point = objects attached to the body were unused (made for the burial) | | | | | | | | | | | | **3** |
| | 1 additional point = raw material of exceptional value (transportation distance/acquisition costs) | | | | | | | | | 1 | 1 | | **2** |
| | 1 additional point = manufacture of exceptional value (work load) | | | | | | | | | | | | **0** |

*Continued on the next page*

| | Number of data set | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Site** | **Abri Cornelle-Sulauze I - 1** | **Abri Cornelle-Sulauze I - 2** | **Abri Cornelle-Sulauze I - 3** | **La Baume de Montclus - 1** | **La Baume de Montclus - 2** | **Le Cuzoul de Garmat** | **Le Poeymaü** | **Le Rastel** | **Abri Sous-Balme** | **Bad Dürrenberg - 1** | **Bad Dürrenberg - 2** | **occurences** |
| Burial equipment: grave goods (several entries possible) | 0 point = no grave goods | 1 | | 1 | 1 | 1 | | 1 | | | | 1 | **6** |
| | 1 point = faunal remains (food offering) | | | | | | | | | | 1 | | **1** |
| | 2 points = all-day equipment from flaked industry | | 2 | | | | 2 | | 2 | | 2 | | **4** |
| | 3 points = all-day simple objects produced from organic materials (bone point, smoothener, axe etc.) | | | | | | | | | 3 | 3 | | **2** |
| | 4 points = B8 complex objects produced from organic materials (spear thrower, perforated baton etc.) | | | | | | | | | | 4 | | **1** |
| | 5 points = role attributes (drumstick etc.) | | | | | | | | | | 5 | | **5** |
| | 1 additional point = raw material of exceptional value (transportation distance/acquisition costs) | | | | | | | | | | 1 | | **1** |
| | 1 additional point = manufacture of exceptional value (work load) | | | | | | | | | | 1 | | **1** |
| | **Total 1** | **6** | **8** | **0** | **6** | **0** | **9** | **8** | **11** | **18** | **40** | **12** | |
| | 1 additional point: body wrapped in leather? | | | | | | | | 1 | | 1 | | **2** |
| | **Total 2** | **6** | **8** | **0** | **6** | **0** | **9** | **8** | **12** | **18** | **41** | **12** | |

workload assumed to be low
workload assumed to be medium
workload assumed to be high/
exceptional burial equipment

**Tab. 4** Data collected for the Magdalenian (source of raw data: Wüller 1999).

***Tab. 4*** *Erfasste Daten für das Magdalénien (Quelle der Primärdaten: Wüller 1999).*

| | Number of data set | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Site** | **Grotte de Les Hoteaux** | **Saint-Germain-la-Rivière** | **Chancelade** | **Laugerie-Basse** | **Cap Blanc** | **Bruniquel, Abri Lafaye - 1** | **Bruniquel, Abri Lafaye - 2** | **Grotte Duruthy - 1** | **Grotte Duruthy - 2** | **occurences** |
| »Meta« data | site type | cave | rock shelter | | | | | | | | |
| | excavation date(s) | 1896–1919 | 1928–1933 | 1887–1890 | 1864–1888 | 1908/1992 | 1884 | | 1873 | 1957–1961 | |
| | stratigraphical position | 6th foyer/-2m | single layer | foyer A (lowermost layer, but in pit from foyer C?) | depth of 4 m, base of arch. horizon | base of foyer inférieur (couche 3) | couche 20 c (layer D)/-0.75 m | | niveau Tn (sq. CIII) | couche 3/4 (sq. DII) | |
| | industry | unknown | 15780 ± 200 uncal BP | 19500–18000 cal BP | 15000 uncal BP | unknown | unknown | unknown | unknown | 13520 ± 220 uncal BP | |
| | number of burials in the site | Magdalenian | Middle Magdalenian | | Magdalenian | Badegoulien or Middle Magdalenian | Late Magdalenian | | | | **11** |
| | number of burials in the site | 1 | 1 | 1 | 1 | 1 | 2 | | 2 | | **9** |
| | number of dead in the same burial | 1 | **1** | 1 | 1 | 1 | 2 (?) | | 1 | 1 | **7** |
| Individual: body position | supine position | | | | 1 | | | | | | **1** |
| | flexed position | 1 | | | | | 1 | | | | **2** |
| | contracted position (taphomy or wrapping?) | | 1 | 1 | | 1 | | | | | **3** |
| | unknown position | | | | | | | 1 | 1 | 1 | **3** |
| Individual: anthropology | infans I (0–6 years) | | | | | | | | | | **1** |
| | infans II (7–12 years) | | | | | | | | | | **0** |
| | juvenile (13–18 years) | 1 | | | | 1 | | | | | **2** |
| | adult (19–40 years) | | 1 | 1 | 1 | | 1 | | | | **4** |
| | matur (40–60 years) | | | | | | | | 1 | 1 | **2** |
| | senile (< 60 years) | | | | | | | | | | **0** |
| | other age estimations | | | | | | | | | | **0** |
| | gender female | | 1 | | | 1 | 1 | | | 1 | **4** |
| | gender male | 1 | | 1 | 1 | | | | | | **3** |
| | gender unknown | | | | | | | 1 | 1 | | **2** |
| | anthropological specifics | | | Athritis, skull trauma | | | | | | | |

*Continued on the next page*

| | Number of data set | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Site | Grotte de Les Hoteaux | Saint-Germain-la-Rivière | Chancelade | Laugerie-Basse | Cap Blanc | Bruniquel, Abri Lafaye - 1 | Bruniquel, Abri Lafaye - 2 | Grotte Duruthy - 1 | Grotte Duruthy - 2 | occurences |
| Burial context | 0 point = all-day conext (e.g. in the centre of activitiy area) | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 8 |
| | 1 point = in separate area within a campsite | | | | | 1 | | | | | 0 |
| | 2 points = special burial site, with several burials | | | | | | | | | | 0 |
| | 3 points = isolated special burial site with single burial | | | | | | | | | | 3 |
| Burial orientation (one entry) | 0 point= random (or unknown) | | | | | | | | | | 2 |
| | 1 point = along a given axis of the site | | 1 | | 1 | | 1 | 1 | | 1 | 6 |
| | 2 points = along compass point | 2 | | | | | | | | | 3 |
| Burial construction (several entries possible) | 0 point = on the ground level | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 2 |
| | 1 point = in natural depression | | | | | | | | | | 0 |
| | 2 points = in artificial pit | 2 | | | | 2 | | | | | 9 |
| | 3 points = (additional) constrcution with material collected from the site (stone slabs) | | 3 | | | | | | 3 | 3 | 7 |
| | 4 points = construction with regionally collected materials (pebbles from river terraces, faunal elements) | | | | | | | | | | 2 |
| | 1 additional point = construction visible on the surface | 1 | 1 | | | | | | 1 | 1 | 4 |
| | 1 additional point = ochre scatter | 1 | 1 | 1 | 1 | | | | | | 4 |
| Burial equipment attached to the body (several entries possible) | 0 point = no pendant | | | 1 | | 1 | 1 | 1 | | 1 | 7 |
| | 1 point = isolated pendant | 1 | | | | | | | | | 2 |
| | 2 points = numerous pendants | | 2 | | | | | | 2 | | 1 |
| | 3 points = pendants attached to headgear or headdress | | | | 3 | | | | | | 1 |
| | 4 points = pendants attached to upper or lower part (clothes) | | | | 4 | | | | | | 1 |
| | 5 points = pendants attached to upper and lower part (clothes) | | | | 5 | | | | | | 0 |
| | 6 points = role attributes attached to the body used during lifetime (e.g. "mask") | | | | | | | | | | 0 |
| | 7 points = materials attached to the body pointing to differential treatment of the dead (e.g. plastered head etc.) | | | | | | | | | | 1 |
| | 1 additional point = objects attached to the body were unused (made for the burial) | | | | | | | | | | 3 |
| | 1 additional point = raw material of exceptional value (transportation distance/acquisition costs) | | 1 | | 1 | | | | 1 | | 2 |
| | 1 additional point = manufacture of exceptional value (work load) | | | | | | | | | | 0 |
| Burial equipment: grave goods (several entries possible) | 0 point = no grave goods | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| | 1 point = faunal remains (food offering) | | 1 | | | | | | | | 1 |
| | 2 points = all-day equipment from flaked industry | | | | | | | | | | 0 |
| | 3 points = all-day simple objects produced from organic materials (bone point, smoothener, axe etc.) | | 3 | | | | | | | | 1 |
| | 4 points = complex objects produced from organic materials (spear thrower, perforated baton etc.) | 4 | | | | | | | | | 1 |
| | 5 points = role attributes (drumstick etc.) | | | | | | | | | | 0 |
| | 1 additional point = raw material of exceptional value (transportation distance/acquisition costs) | | | | | | | | | | 0 |
| | 1 additional point = manufacture of exceptional value (work load) | | | | | | | | | | 0 |
| | Total 1 | 11 | 13 | 1 | 15 | 3 | 1 | 1 | 8 | 5 | 40 |
| | 1 additional point: body wrapped in leather? | | 1 | 1 | | 1 | | | | | 1 |
| | Total 2 | 11 | 14 | 2 | 15 | 4 | 1 | 1 | 8 | 5 | 41 |

workload assumed to be low
workload assumed to be medium
workload assumed to be high/ exceptional burial equipment

**Tab. 5** Data collected for the Mesolithic (source of raw data: Grünberg 2000).

***Tab. 5*** *Erfasste Daten für das Mesolithikum (Quelle der Primärdaten: Grünberg 2000).*

## Results

The results are presented in two sections: individual scores and cumulated scores. Due to the small number of cases, we will refrain from further elaborate statistical analysis. Therefore, all analysis takes advantage of natural numbers. More specifically, individual scores record each burial separately, whereas cumulated scores result from the addition of scores or the summed-up presence or absence of attributes in categories to display the total amount of workload the respective groups are willing to invest in the burial equipment of their dead members.

| Potential bias | | Archaeological evidence supporting presence of bias | Consequences | Bias present in this study? |
|---|---|---|---|---|
| Reduced representativity of dataset due to limitation to inhumation graves | Differential access of group members to burials with the deposition of the entire body? | Secondary burials of (cremated) body parts (e.g. in the Magdalenian of Brillenhöhle: Orschiedt 2013) and the Mesolithic (Grünberg 2000) | Sample biased by social selection towards higher status and prestige | Highly probable |
| Reduced representativity of dataset due to overrepresentation of burials in settings which have higher chances of being excavated (caves, base camps) | Differential access of group members to burials at camp sites? | Presence of isolated burials in the Paleolithic (e.g. Brno II: Oliva 2000; Bad Dürrenberg: Orschiedt et al. 2023); 46 % of Mesolithic burial sites are open air sites (Grünberg 2000, Tab. 2) | Sample biased by social selection and probability of site discovery (especially in the case of open-air burial sites) | yes |
| Reduced representativity of dataset due to selective excavation methods | Early dates of excavation lead to loss of information? | Most Magdalenian burials in French rock shelters and caves were excavated before WW II | Unreliable information about/interpretation of stratigraphy, burial pits, stone constructions etc. | yes |
| Reduced representativity of dataset due to limitation on hunter-gatherers with comparable subsistence tactics (e.g. primarily focus on terrestrial game) | Burials of large Mesolithic burial from aquatic/marine subsistence tactics more informative in search for differences in status and prestige? | Sample does not include Mesolithic burial grounds, which may have > 100 burials (Grünberg 2000, Tab. 2) | A large part of Mesolithic burials is missing | yes |

**Tab. 6** Possible shortcomings of the dataset.

***Tab. 6*** *Mögliche Unzulänglichkeiten des Datensatzes.*

## Individual burial scores

### *Total burial scores*

In the Magdalenian (Fig. 2), burial scores range between one point for the two burials from Bruniquel, Dép. Tarn-et-Garonne, France, and 15 points for the burial from Laugerie-Basse, Dép. Dordogne, also France. The increase in total scores per burial, visualised by their rank order, is almost constant. At the same time, with the two exceptions at the very lower end of the value range, each burial has a different total score. The Mesolithic scores are more unevenly dispersed. If Bad Dürrenberg is not considered, scores range between 0 and 18, which is roughly the same range as in the Magdalenian. However, the increase is less constant, as there is a considerable gap between the lowermost score of 0 and the next group with values between 6 and 12 points. Another gap is between Le Rastel, Commune de Peillon, Dép. Alpes Maritimes, France, with 12 points and Abri Sous Roche de La Balme de Thuy, Dép. Haute-Savoie, France, with 18 points. These differences in the steps of increasing burial scores may be rooted in the imprecision of the scoring system applied, because scores are given by rank order instead of actual workload. The jump of values between Abri Sous Roche de La Balme de Thuy and Bad Dürrenberg of twenty-three points is another matter and certainly reflects marked differences in burial equipment. The more weighted distribution of economic efforts invested in the Mesolithic individual burials is better visible in the lower part of Fig. 2, which shows the frequency of cases for burial scores in the two datasets. In the Magdalenian, the distances between neighbouring scores are low, whilst the Mesolithic distribution is characterised by clustering within the lower values ≥ 12 points, followed by large gaps in the higher values.

### *Burial score and age*

The question here is to what extent the age of the individuals may have influenced status and prestige. Again, it must be mentioned beforehand that the analysis is weakened by the small number of cases. Thus, the methodological discrimination against younger age classes, due to their shorter time span and the higher vulnerability of the skeletons of very young individuals to decomposition, results in a weighted distribution of age classes, which in both datasets is best described as unimodal with a peak in the age class of adults (Fig. 3). The major premise in the social analysis of hunter-gatherers is the assumption that social hierarchies are low and that social positions with higher status and prestige are not inherited but need to be earned by performance. Given the individual ownership of gear and valuable objects, one would expect an increase of burial attributes indicating higher status and prestige with an increase of age and, after reaching the maximum, a plateau in the following age classes. The following observations (deduced from Fig. 3) deviate from this expectation and therefore require explanation (note that the comparably high score of the infant from Bad Dürrenberg 2 is omitted here because it is possibly a secondary burial):

a) a large variability of scores in the class of adults resulting from the presence of very low scores, and
b) the fact that adults reach the highest scores, but at the same time, mature and senile individuals all have low to very low scores.

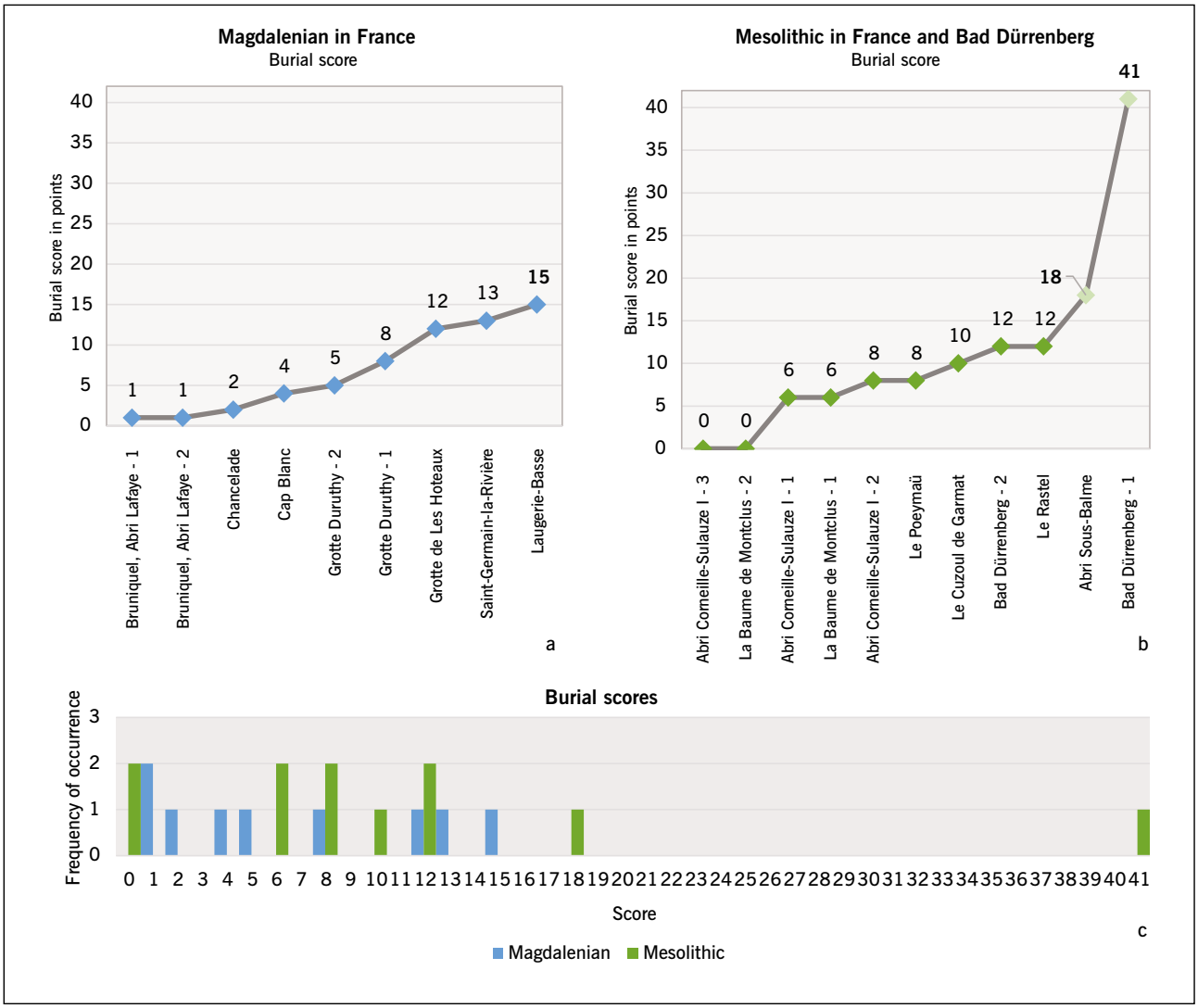


Fig. 2a–c Burial scores.

*Abb. 2a–c Bewertung der Bestattungen.*

*Burial score and gender*

The problem of small numbers also affects the examination of potential relations between burial score and gender. Nonetheless, the resulting diagrams (Fig. 4) are briefly described below. In the Magdalenian dataset, the ratio between male and female individuals among the buried is almost equal. The same applies to the partition of burial scores, where both females and males appear among burials with low and high scores. The difference between the high score in female burials of 14 points and that of male burials of 15 points is negligible. When the comparison is confined to burials from France, the picture in the Mesolithic is markedly different. In contrast to the Magdalenian, the maximum score in the Mesolithic male burials of 18 points is three times higher than the highest score in the female burials. The picture changes notably with the inclusion of Bad Dürrenberg. Following the argument that the bulk of burial equipment was dedicated to the adult woman, this burial aggregates a burial score that more than doubles the highest score for male burials.

## Cumulated burial scores

The informative value of a summation of burial scores for broad categories (Fig. 5) might be called into question, as the focus in the analysis of burials is on the status and prestige of individuals. However, it might also be interesting to know what aspect of burials a community (virtual, in the studied cases) is willing to invest in, or vice versa, what burial features are accepted to designate higher status and prestige. From such an economic perspective, the Magdalenian and Mesolithic burials show marked differences. In the Magdalenian, the burial construction and the burial equipment attached to the body (by and large identical to clothing) reach by far the highest scores, which are very similar to each other. It is of note here that the attribute ›body wrapped in leather‹ was counted as part of the burial construction. In contrast, in the Mesolithic, the score for the category ›burial construction‹ exceeds all others by far, independent of the inclusion or exclusion of the Bad Dürrenberg burial. Whether this difference can be interpreted as a shift in signals for status and prestige from items personally owned by the individual during their lifetime (e.g.

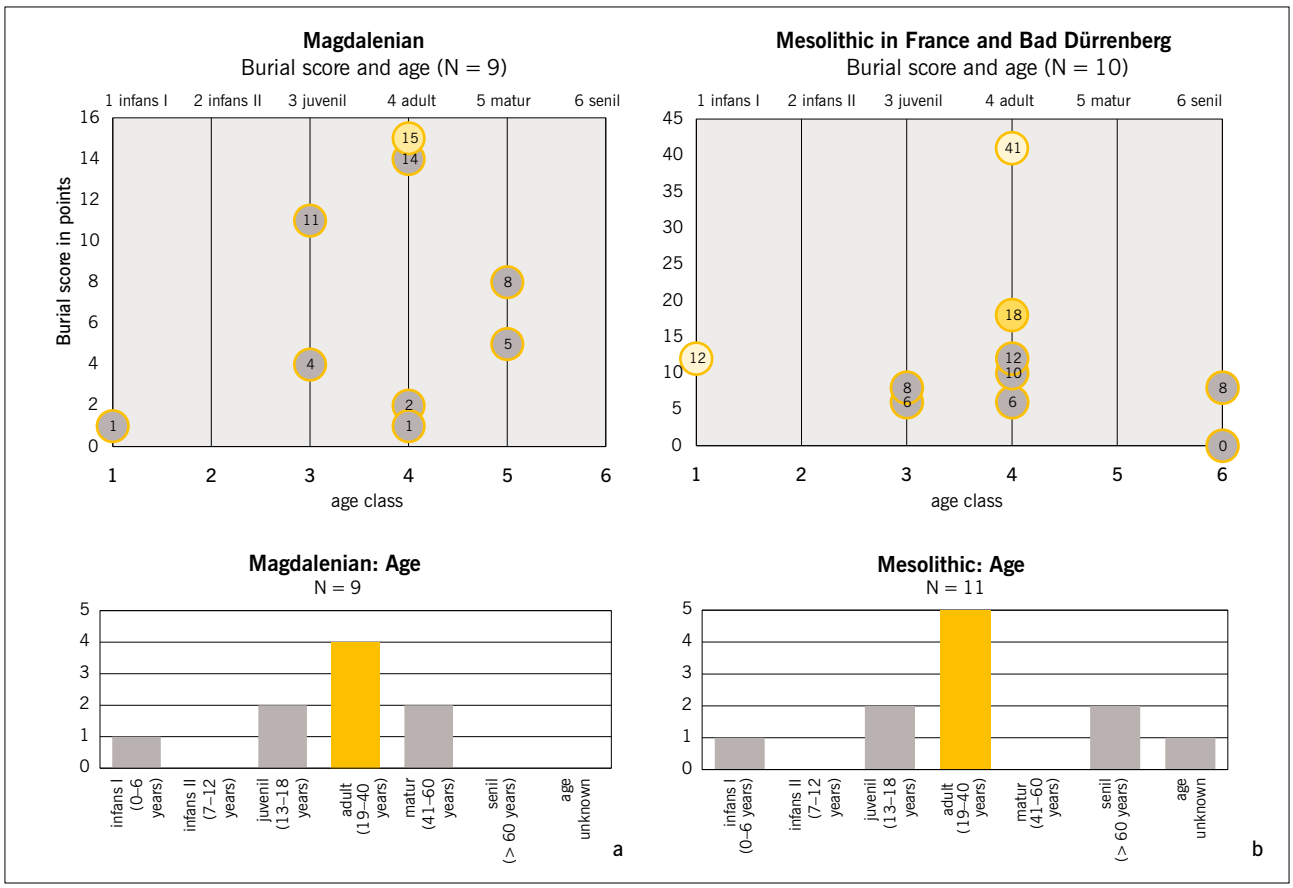


**Fig. 3a–b** Burial scores and age (orange: maximum; light orange: scores calculated for Bad Dürrenberg).

***Abb. 3a–b*** *Bestattungswertungen und Alter (orange: Höchstwert; hellorange: für Bad Dürrenberg berechnete Werte).*

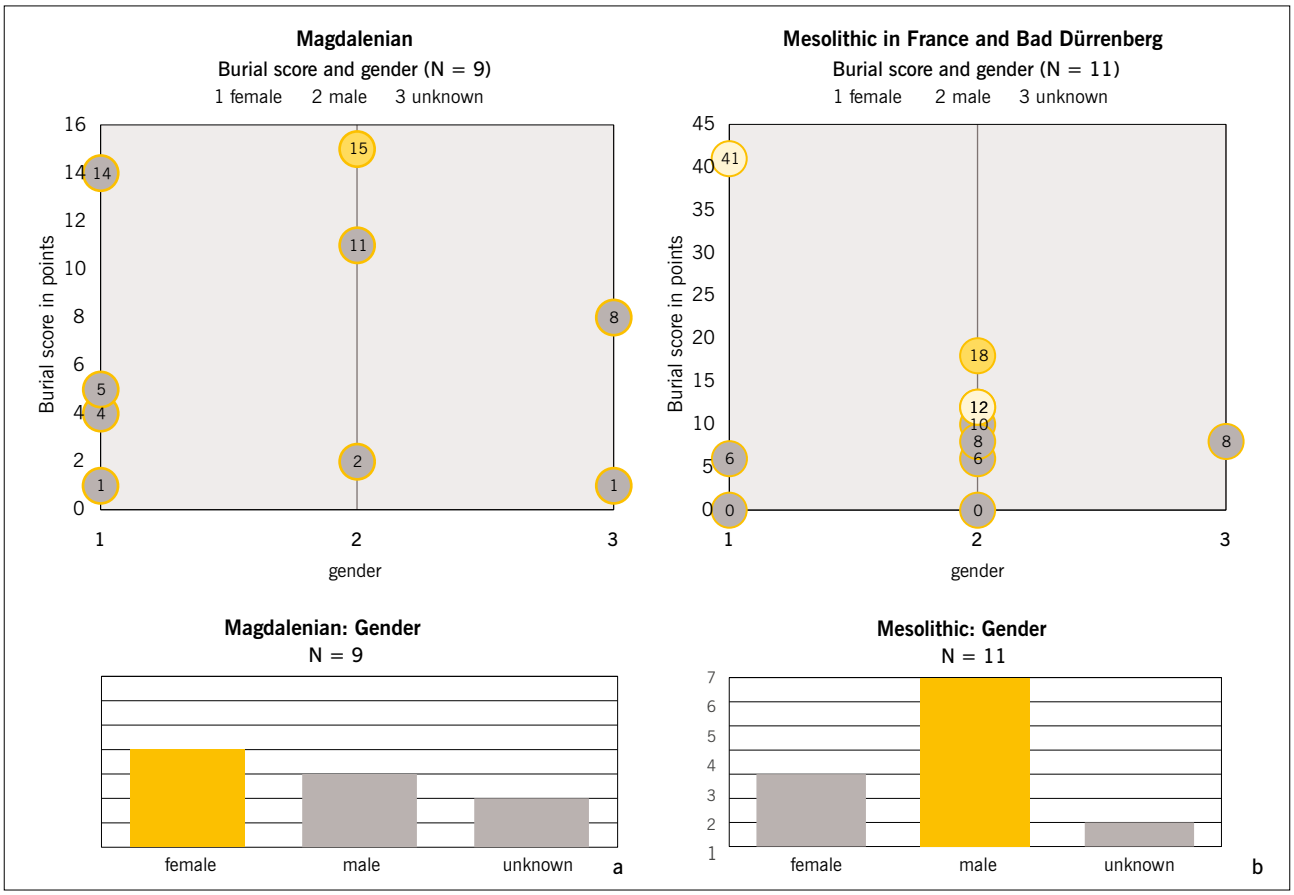


**Fig. 4a–b** Burial scores and gender (orange: maximum; light orange: scores calculated for Bad Dürrenberg).

***Abb. 4a–b*** *Bestattungswerte und Geschlecht (orange: Maximum; hellorange: für Bad Dürrenberg berechnete Werte).*

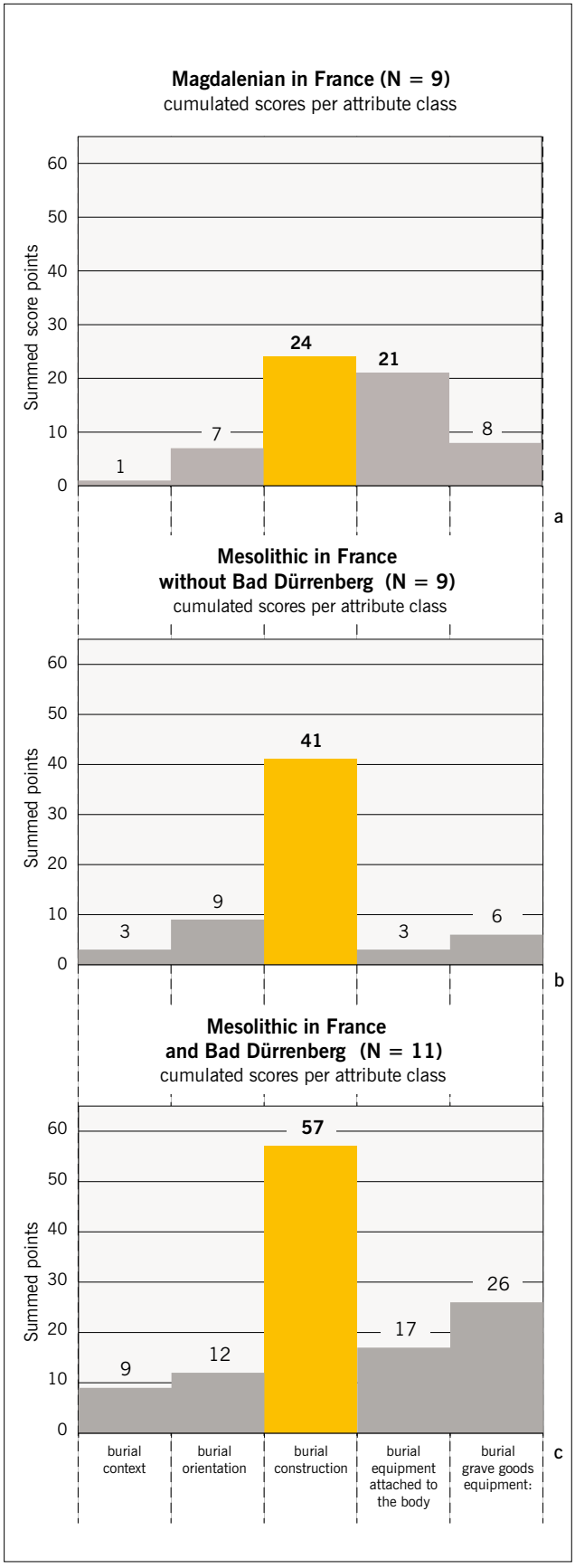


**Fig. 5a–c** Cumulated burial scores (orange: maximum; note that the attribute ›body wrapped in leather‹ was counted as part of the burial construction).

***Abb. 5a–c*** *Kumulierte Bestattungswerte (orange: Maximum; zu beachten wäre, dass das Attribut »in Leder eingewickelter Körper« als Teil der Bestattungskonstruktion gezählt wurde).*

clothing) to investments made by the burying community for the dead (e.g. burial construction) will be discussed in the following section.

## Discussion

Due to the weak database, the results of the present study (Fig. 6) should be treated with caution. At best, they can be taken as the results of a pilot study aiming at the application of an economic scoring system to prehistoric hunter-gatherer burial contexts. However, it is questionable whether enlarging the geographical scale would have also substantially enlarged the dataset – at least for the Magdalenian. For example, Magdalenian/Epi-Gravettian burials are more numerous in Italy, but these are heavily disturbed in an overwhelming number of cases (Orschiedt 2013). In contrast, widening the geographical scope of Mesolithic burials to the entirety of France would, indeed, lead to an increase in cases (Boulestin 2018). Although the number of burials in Mesolithic necropoleis near the French Atlantic coast, such as Téviec, Dép. Morbihan, is again limited, especially when compared to Scandinavian sites from the late Mesolithic, e.g. Skateholm, Skåne County, Sweden and Bøgebakken, North Jutland, Denmark (Larsson 2016), an inclusion of groups exploiting marine and/or aquatic resources would have enlarged the dataset (see also Meiklejohn et al. 2021). However, at the same time, that would have made it incongruent with the Magdalenian data due to different subsistence tactics. Within the methodological presumption that, in hunter-gatherer groups, the economic value of the burial equipment is an appropriate indicator of the status of a social position and/or the prestige of the position holder, both the Magdalenian and the Mesolithic datasets show the presence of differences in the socioeconomic status and prestige of the buried. However, the findings are not identical. Instead, Mesolithic groups seem to have allowed larger differences in economic status linked to social positions than those of the Magdalenian.

### Total burial scores

Marked differences were observed in the analysis of the total amount of workload invested in the burials of the Magdalenian and the Mesolithic periods. The range and the gradient of total scores are much higher in the Mesolithic. At the same time, it is characterised by clusters rather than a constant increase as in the Magdalenian. Two hypotheses can be deduced from this:

1. In the Mesolithic, the weighted and unbalanced distribution of burial scores accompanied by a top-ranking position distant to the remaining individuals mirrors marked differences in status and prestige indicative of a transegalitarian society. The more clustered increase of scores might indicate the existence of several, albeit vaguely defined, classes of socioeconomic status.
2. In the Magdalenian, the continuous increase of burial scores combined with the absence of larger gaps and

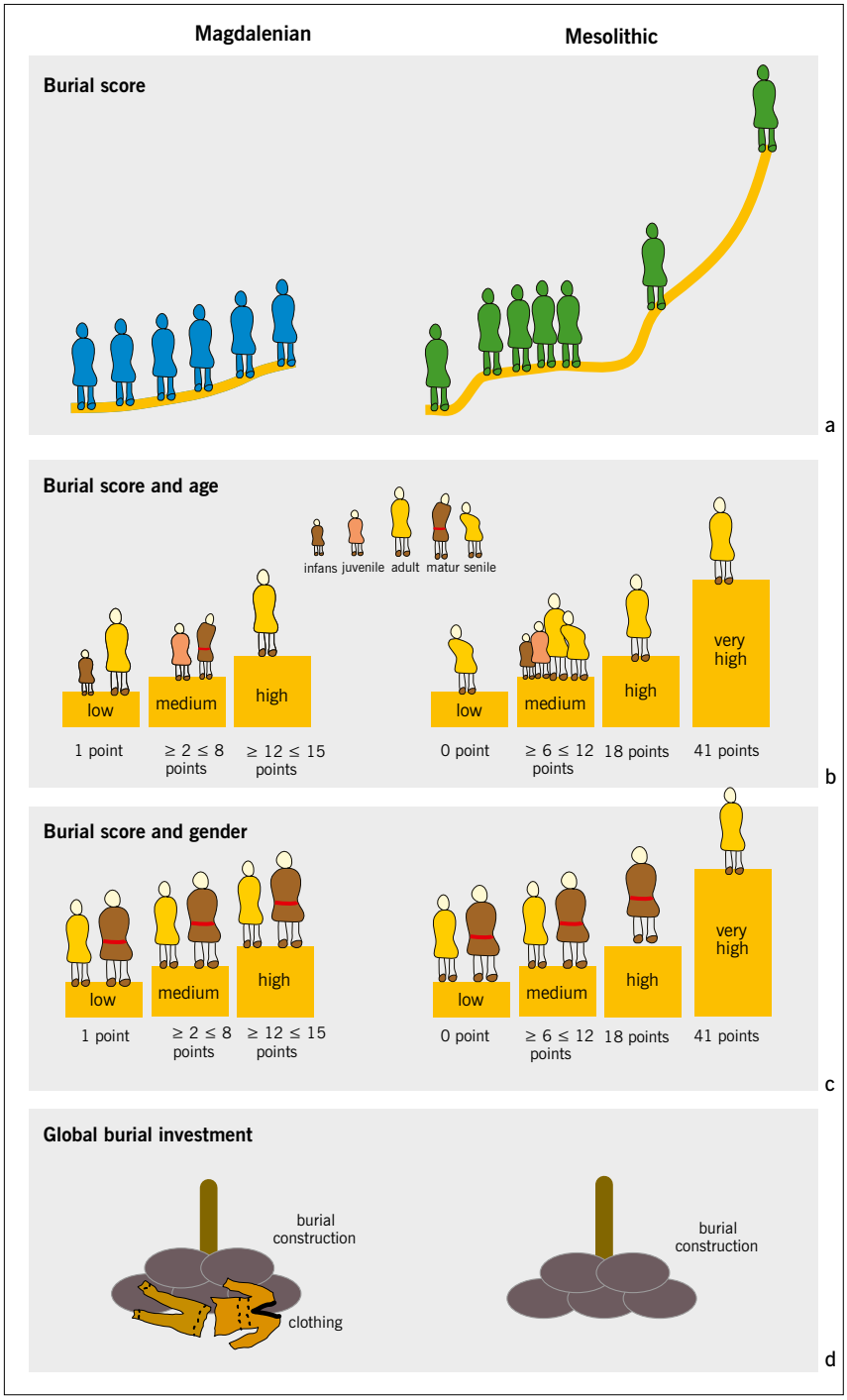


**Fig. 6a–d** Comparison of major results of the present study.

***Abb. 6a–d*** *Vergleich der wichtigsten Ergebnisse der vorliegenden Studie.*

without extremely high values all speak for less economic difference in status and prestige, thus indicating an egalitarian society. Furthermore, the fact that each burial has a different score indicates a more nuanced relation between status and prestige on the one hand and the individual performance of the buried holders of social positions on the other.

## Burial scores, gender and age

Despite the limited representativity of the dataset already discussed in length above, gender seemingly did not influence the chances of becoming the holder of a social position with higher status and prestige. Regarding access to such positions in relation to age, it is more difficult to decide to what extent the low number of cases blurs the distribution of burial scores in age classes. Firstly, this applies to the estimation of age at death. In both datasets, adults dominate the distribution of age classes among the buried individuals. One argument for taking this as a sign of statistical bias is the imbalance within the ranges of the ages estimated. Age estimations of young individuals have a higher precision, leading to a higher resolution of the age classes, which cover a span of around 5 years. Conversely, the age classes of adult and mature individuals are as large as 20 years.

This enlargement favours larger numbers of individuals, thus increasing the chances of advanced variability. However, besides the fact that the frequencies of adult, mature, and senile individuals with some probability meet the actual life expectancy of hunter-gatherers at the time (Uthmeier 2023, 365–369), any explanation solely based on statistical biases is further weakened by the observation that both datasets show the same basic relation between burial scores and age classes. In the Magdalenian and Mesolithic alike, burial scores of adults reach a peak and have the largest range, whereas the burial scores of the young, as well as those of mature and senile individuals, are lower. This justifies suggesting the following hypotheses:

1. The occupation of social positions with higher status and prestige was not heritable.
2. The acceptance of candidates for social positions with higher status and prestige resulted from performance or, more precisely, performance accumulated with increasing age. The kind of performance remains unknown. It is possible that this was related to situations in which candidates for prestigious social positions proved their value, or whose performances resulted in the cumulation of knowledge and skills. Following this line of argument, the burials of adults with low scores could be explained by group members who were less successful in this regard.
3. The regular fallback of burial scores of mature and senile individuals behind those of adults may indicate that higher economic status and prestige, or their material visibility, was not a life-long privilege.

While the first two hypotheses meet general expectations, the last hypothesis deserves more attention. It presumes that the lack of rich burials of older individuals is not random, e.g. a consequence of the low number of cases, but in fact, the result of passing valuable objects to younger successors. In the run-up of the discussion, it is important to note that measuring burial scores only makes it possible to elucidate the economic aspect of status and prestige in its materialised form – and only if it is visible in the archaeological remains of the burial of the respective individual. Therefore, a higher status and prestige not expressed by valuable burial goods cannot be recognised. Consequently, it is impossible to answer the question of whether Magdalenian and Mesolithic holders of positions with higher status and prestige nevertheless kept their authority and still met with similar esteem after the suggested recession. What can be reflected on is the character of the objects potentially passed. To explore this aspect further, a diagram was calculated for the summed scores of burial categories sorted by age class (Fig. 7). It enables the identification of the main difference between adult burials on the one hand, and those of senile or mature individuals on the other, which is to be found in burial equipment attached to the body, e.g. clothing. In the Magdalenian, the exceptionally high score of the burial from Laugerie Basse in this category (total burial score: 15 points) differentiates it from all other burials from this period. The same applies to the Mesolithic, where the category ›burial equipment attached to the body‹ shows an exceptional drop of points between the burial of adults (e.g. Abri sous Roche de La Balme de Thuy, total burial score: 18 points, and Bad Dürrenberg-1, total burial score: 41 points) and those of the mature individuals from Abri Corneille-Sulauze I-1, Commune d´Istres, Dép. Bouches-du-Rhône, France, and Abri Corneille-Sulauze I-3, Commune d´Istres, Dép. Bouches-du-Rhône, France. Consequently, and with all caution, one hypothesis drawn from this is that valuable clothing, e.g. caps, anoraks, and/or trousers decorated with pendants indicating higher status and prestige, was passed from generation to generation. If so, valuable clothing would have to be counted as a role attribute. Following B. Hayden´s (1998) differentiation between practical and prestige technologies, valuable clothing would belong to the prestige technologies and, more precisely, to ritual technologies with restricted – in this case, temporal – private ownership.

## Cumulated scores

The values mirroring the overall investment of synthetic Magdalenian and Mesolithic groups can best be summarised as follows: while in the Magdalenian the burial construction and the equipment attached to the body reach the by far highest scores, reaching almost the same level, Mesolithic burial scores are dominated by high values in the category of burial constructions. A closer look at the distribution of attributes within this category reveals that burial constructions visible on the surface are found in both datasets in equal but relatively low numbers (four burials each). Valuable burials are, therefore, not so much characterised by surface visibility after the burial but by features merely visible during the time of construction and the burial ceremony itself, such as a burial pit or stone slabs later covered by sediment. Interestingly, the scores for burial constructions are quite similarly distributed among the age classes in the Mesolithic but not so in the Magdalenian. This being said, the differences observed allow for further consideration of the agency of valuable burial goods. In the Magdalenian, valuable burial equipment attached to the body was at least potentially acquired during the lifetime by the personal performance of the buried individual, whereas in the Mesolithic, investment in the burial construction was provided by the living for the dead. In theory, this would allow numerous members of the burying community to contribute to the overall burial value, e.g. by donating stone slabs or producing part of the ochre.

## Further thoughts on the low frequency of Magdalenian and Mesolithic burials

C. Jeunesse (2021) postulated an underrepresentation of burials in relation to the overall populations in prehistoric hunter-gatherer groups. While this is more than obvious for the Magdalenian, the latest collection of Mesolithic burial data (Meiklejohn et al. 2016) requires a short review here. Their data set, which comprises sites from the entirety of Europe, includes 211 sites – a larger num-

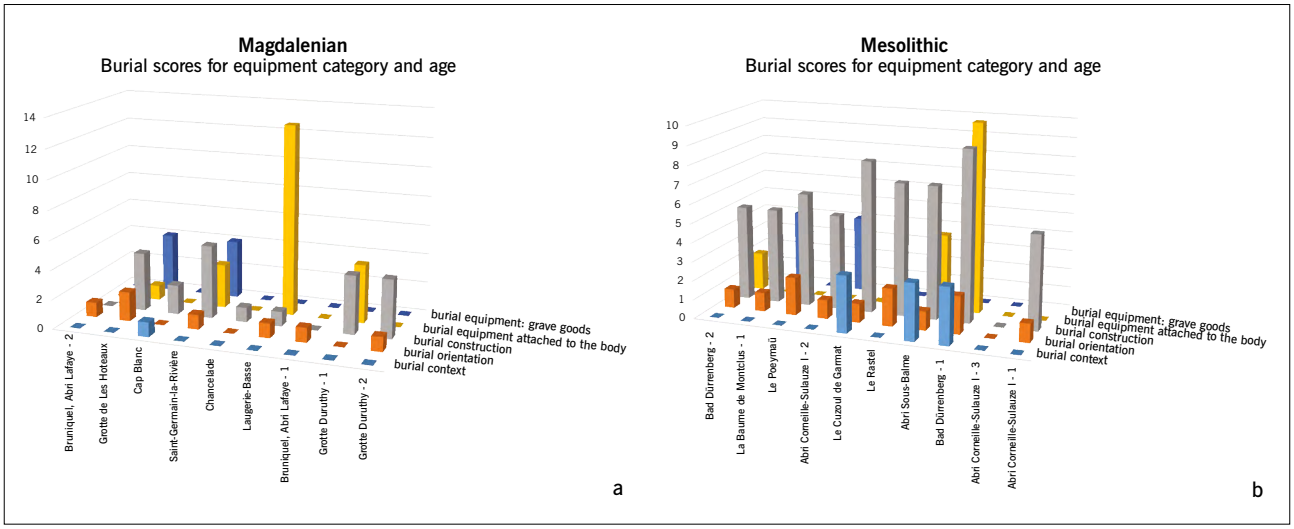


**Fig. 7a–b** Summed scores for different burial categories in age classes.

***Abb. 7a–b*** *Summenwerte für verschiedene Bestattungskategorien nach Altersklassen.*

ber by far than in the Magdalenian. Does this mean that the case of underrepresented burials does not apply to the Mesolithic? The above-cited data review comprises burial sites from coastal, near-coastal and inland areas and, therefore, contains substantially different subsistence tactics. The latter influence the respective land use patterns, which in turn may lead to differences in burial customs. For example, it is assumed that the primary use of spatially and/or seasonally localised aquatic resources such as shellfish, mussels or freshwater fish is coupled with a land use pattern characterised by longer occupations and repeated site use (Marchand 2007). In Brittany, ›semi-sedentary‹ Mesolithic lifeways are coupled with the emergence of large burial grounds (Marchand 2007, 227–229). Excluding coastal and inland river contexts relativises the number of burials per site. In total, the range is from 1 to 177, but in most cases absolute numbers are quite low: the median for the number of burials per site is only two (Meiklejohn et al. 2016, 30), meaning that half of the Mesolithic burial sites have only one or two burials. Given that most of the large burial grounds correlate with aquatic resource procurement, it follows that burials in nomadic Mesolithic hunter-gatherer groups with subsistence tactics based on terrestrial game are also an exception. According to C. Jeunesse (2021), this underrepresentation is related to a specific perception of the supernatural powers of the dead. In contrast to egalitarian or ranked societies with sedentary lifeways, who see their dead as helpful ancestors remembered through elaborate funeral rites and even memorials, nomadic hunter-gatherers often see their dead as harmful ghosts that must be banished from the sphere of the living and erased from the memory of the group. In this sense, C. Jeunesse (2021) argues for erased memories in the Upper Palaeolithic and Mesolithic. However, the question of the extent to which the few existing inland burials from the Magdalenian and Mesolithic periods, and especially those with high burial scores, can already be interpreted as the intention to construct ancestors is difficult to answer.

## Conclusion

The baseline of the present article is the assumption that differences in status and prestige exist in almost all human societies. Whereas the presence of different social positions in the simplest form is related to gender, age, and division of labour, differences in status and prestige are the consequence of the group´s rating of the importance of social positions for the community, as well as the individual performance of the position holders. Although status and prestige are two dimensions of the societal complement of social positions, it is impossible to differentiate them in archaeological contexts due to the lack of emic information. Therefore, status and prestige are treated as one variable investigated using a socioeconomic approach. The most promising way to couple status and prestige on the one hand and archaeological material culture on the other is seen in burials. Consequently, the present pilot study tests a newly developed scoring system for evaluating the socioeconomic status of individuals in prehistoric hunter-gatherer burials with the help of a diachronic dataset from the French Magdalenian and Mesolithic. Judged from a socioeconomic perspective, Magdalenian groups had an egalitarian societal organisation, whereas in the Mesolithic societal hierarchy was more elaborated. Regarding the occupation of positions with high status and prestige, gender does not seem to have been a criterion. What seems to have been a precondition for acquiring higher status and prestige in both industries is age, coupled with performance. Surprisingly, mature and senile individuals have lower scores, possibly indicating a loss of economic privileges in a phase of reduced social activity. Another conjunctive element is a peak in the economic significance of equipment attached to the body, e.g. clothing, in burials with the overall highest burials scores, in each case found in the adult age class. This finding, although weakened by the low number of cases, is interpreted as a transfer of clothing from a former position holder, who had become inactive through age, to the

succeeding active position holder. If so, valuable clothing would have the societal meaning of a role attribute. Despite differences in the general investment in burial construction, which was much more common in the Mesolithic, the economic value of burials in both industries was mostly hidden once the burial ceremony had ended.

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## Source of figures

1–7 author
Tab. 1–6 author

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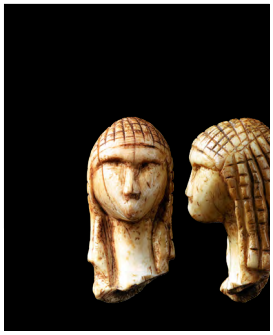
# SEKTION VII: KLEIDUNG UND KÖRPERSCHMUCK IN STEINZEITLICHEN KÜNSTLERISCHEN KONTEXTEN

# SECTION VII: CLOTHING AND BODY ORNAMENTATION IN STONE AGE ARTISTIC CONTEXTS



Dieses Kopffragment einer jungpälolithischen Elfenbeinstatuette (»Dame à la Capuche«) wurde in einer Höhle bei Brassempouy, Département Landes (Frankreich) gefunden (Foto: Jean-Gilles Berizzi; Upload: Elapied, Wikimedia Commmons, gemeinfrei).

*This head fragment of an Upper Palaeolithic ivory figurine (»Dame à la Capuche«) was found in a cave in Brassempouy, Landes Department (France; Photo: Jean-Gilles Berizzi; Upload: Elapied, Wikimedia Commmons, Public Domain).*

# A Palaeolithic and Mesolithic artistic record of clothing – an overview

Olaf Jöris

**Zusammenfassung**

Darstellungen von Kleidung in der Kunst des Paläolithikums und Mesolithikums – ein Überblick

*Menschliche und anthropomorphe Darstellungen sind im eurasischen Jungpaläolithikum und Mesolithikum relativ häufig anzutreffen. Der vorliegende Artikel gibt einen Überblick über diese reichhaltigen Funde, strukturiert sie und interpretiert sie. Allerdings werden Menschen niemals so dargestellt, wie sie sich im Alltag kleideten. Bilder von vollständig bekleideten Körpern fehlen oder sind schwer zu identifizieren. Die detaillierteren Figuren, die meist dem mittleren und frühen späten Jungpaläolithikum zugeordnet werden, sind größtenteils nackt dargestellt, manchmal jedoch mit Kleidungsstücken oder Körperornamenten ausgestattet, die mit bemerkenswerter Detailgenauigkeit plastisch gestaltet oder graviert sein können. In solchen Fällen scheint die Kleidung auf Markierungen reduziert zu sein, die möglicherweise Attribute hervorheben, die als direkt mit tatsächlichen Personen aus der Vergangenheit in Verbindung stehend interpretiert werden. Unter den am detailliertesten dargestellten Merkmalen wird eindeutig der Darstellung von Kleidungsstücken aus Fasern der Vorzug gegeben, während Lederprodukte in den künstlerischen Darstellungen unterrepräsentiert oder schwer zu erkennen sind. Im Gegensatz zu solchen Funden sind anthropomorphe Darstellungen aus dem späten Jungpaläolithikum sehr schematisiert und bestehen aus vereinfachten weiblichen Figuren und ebenso vereinfachten Silhouetten, die oft in Gruppen angeordnet sind. Naturalistischere Darstellungen sind in dieser Zeit selten, was so interpretiert wird, dass der Schwerpunkt eher auf den sozialen Rollen der Individuen als auf ihrer Individualität lag. Ab dem Spätglazial sind überregionale ikonografische Veränderungen in fast ganz Europa zu verzeichnen. Anthropomorphe Darstellungen werden selten und die wenigen bekannten aus dem europäischen Mesolithikum sind mit geometrischen Mustern gefüllt. In diesem Beitrag wird diskutiert, ob solche Muster lediglich zum Zweck der Verzierung nach bestimmten geometrischen Stilkonventionen aufgebracht wurden oder ob sie die zunehmende Verwendung von Textilien zur fast vollständigen Bedeckung des menschlichen Körpers widerspiegeln. Diese Themen werden im Zusammenhang mit demografischen, genetischen und sozialen Veränderungen während des Jungpaläolithikums und Mesolithikums diskutiert.*

**Schlagwörter** Skulpturen und Gravuren, Kleidung aus tierischen Ressourcen, Technologien zur Herstellung von Kleidung aus Pflanzenfasern, Ikonografie

**Summary**

*Human and anthropomorphic depictions are relatively frequent in the Eurasian Upper Palaeolithic and Mesolithic record. This paper reviews, structures, and interprets this rich record. However, humans are never shown as they dressed in daily life. Images of completely dressed bodies are absent or difficult to identify. The more detailed figures, which are mostly assigned to the mid-Upper and early Late Upper Palaeolithic, are largely displayed naked, although they are sometimes equipped with items of clothing or body ornamentation that may be carved or engraved at a remarkable level of detail. In such cases, clothing seems to be reduced to markers, potentially highlighting attributes that are interpreted as relating directly to actual past individuals. Among the most detailed attributes represented, a clear preference is given to the illustration of fibre-based clothing items, whereas leather products seem to be underrepresented or difficult to recognise in artistic depictions. In contrast to such finds, Late Upper Palaeolithic anthropomorphic images are often schematised, comprising simplified female figures and equally simplified silhouettes, frequently assembled in groups. More naturalistic representations are rare in this period, which is interpreted as a time when the focus was mainly on the social roles of individuals rather than on their individuality. From the Late Glacial onwards, major supra-regional iconographic changes affect almost the whole of Europe. Anthropomorphic depictions become rare, and the few known in Mesolithic Europe are filled with geometric patterns. This paper considers whether such patterns were simply applied for the purpose of ornamentation according to certain geometric style conventions, or if they reflect the growing use of textiles for a near-complete coverage of the human body. These topics are discussed in relation to demographic, genetic, and social changes throughout the Upper Palaeolithic and Mesolithic.*

**Keywords** Sculptures and engravings, clothes made of animal resources, plant fibre-based clothing technologies, iconography

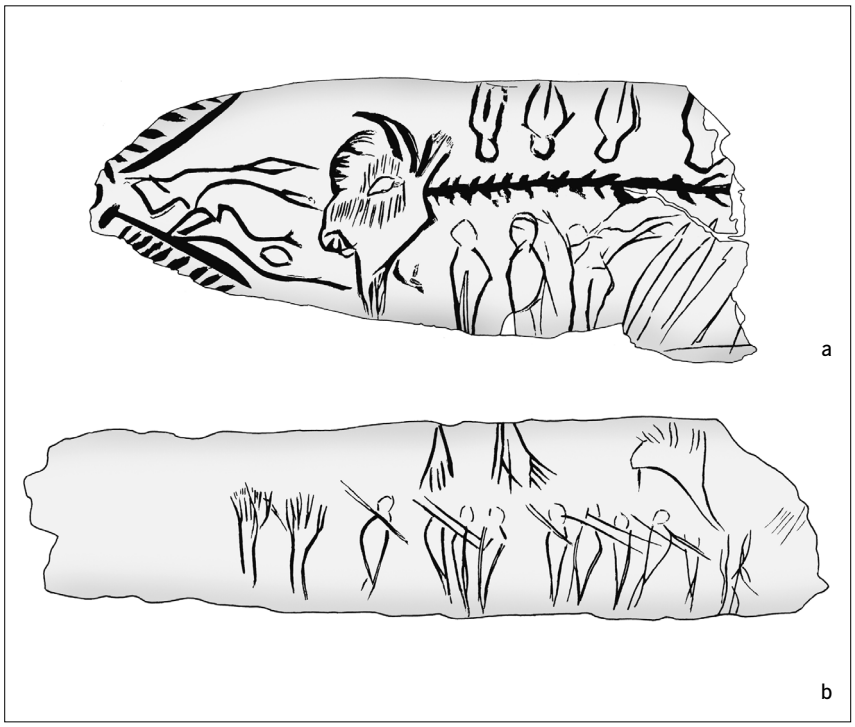



**Fig. 1a–b** Anthropomorphic silhouettes from French Final Magdalenian contexts at (a) Abri Raymonden, Chancelade, and (b) Abri du Châteaux, Les Eyzies (both Dordogne Department). Not shown to scale, but adjusted to a similar torso size for better comparability.

***Abb. 1a–b*** *Anthropomorphe Silhouetten aus französischen Fundstätten des späten Magdalénien in (a) Abri Raymonden, Chancelade, und (b) Abri du Châteaux, Les Eyzies (beide Dép. Dordogne). Nicht maßstabsgetreu, aber zur besseren Vergleichbarkeit auf eine ähnliche Torso-Größe angepasst.*

## Introduction

The Eurasian Palaeolithic and Mesolithic periods have provided a rich record of artistic expressions. Whereas the canon of figurative artistic expressions from the Palaeolithic is chiefly characterised by comparatively naturalistic representations of animals, humans, therianthropes or hybrid figures, displaying attributes of both humans as well as animals (e.g. Leroi-Gourhan 1971), the Mesolithic record tends to be far more abstract, with a stronger focus on geometric elements and patterns, and far fewer examples of figurative art (Płonka 2003 for an overview; cf. Grünberg et al. 2023). These major differences in artistic styles or trends are also reflected in anthropomorphic or human images, which are relatively frequent in the Eurasian Upper Palaeolithic record but appear only occasionally in Mesolithic contexts (e.g. Jonkus 2021; Płonka 2021). The Palaeolithic depictions have been compiled by a variety of authors[1], whereas only a few papers focus on Mesolithic anthropomorphic depictions, as these are far less frequent (Płonka 2003; Grünberg et al. 2023). This contribution will focus on the evidence for clothing that is represented in Palaeolithic to Mesolithic depictions across Eurasia[2].

As most Palaeolithic to Mesolithic human or anthropomorphic figures lack detail, whether painted, engraved in parietal or mobiliary art, or three-dimensionally sculpted, their interpretation may vary among different authors. This lack of detail also affects the interpretation of decorative items, including clothes, which are shown only rarely. When referred to clothing, not only clothing items that can be recognised without doubt, are mentioned. Given the lack of detail or the often simple and schematic style of many figures, frequently only very few or short lines are engraved, for example between the upper and lower body that could be interpreted as belts. Likewise, in many cases, one cannot decide whether hoods, hairstyles, or hairnets are represented. Hampered by such uncertainties, the present contribution does not attempt to present a comprehensive record of clothing in Palaeolithic to Mesolithic art, but instead aims to highlight some aspects that seem to have been overlooked in past studies of anthropomorphic and human depictions.

Most hints at clothing come from portable art and comprise three-dimensionally sculpted objects or ›two-dimensional‹ engravings, the latter sometimes arranged in scenic groupings of different anthropomorphic (or human) figures. The compiled evidence is listed figure-wise, i.e. counting each figure individually, in Tab. 1. As the potentially Levantine Mesolithic rock art is excluded here (see footnote 2), the only more important site with parietal art and hints at clothing referred to in the present study is the Grotta delle Incisioni all'Addaura in Sicily, Italy (Di Maida et al. 2020).

1 E.g. Delporte 1979; Delporte 1993; Duhard 1993; Duhard 1996; Abramova 1995; Bosinski et al. 2001; Cohen 2003; Svoboda 2007; Svoboda 2008; Gaudzinski-Windheuser/Jöris 2015; Farbstein 2017; Pettitt 2017.

2 Whereas the rock art of the Iberian Peninsula had initially been assigned to the Late Palaeolithic to Mesolithic due to the frequent presence of (sometimes scenic) hunting depictions, its age remains highly debated. A significant number of images in Levantine rock art represent humans, often accompanied by indications of clothing or headgear (e.g. Santos Da Rosa et al. 2021). However, as the majority of these depictions must now be assigned to the Neolithic (e.g. López-Montalvo 2018), other evidence may still belong to the Late Palaeolithic or Mesolithic periods, although more dating evidence is required (e.g. discussion in Ruiz López 2023). As such, this source material is excluded from the present study, although it will be referred to briefly at the end of this contribution. For similar reasons, the site of Lepenski Vir, Serbia, is also excluded from the study (e.g. Brami et al. 2022; Brami et al. 2025).

Beyond the focal point of the discussion of the material collated in Tab. 1 concerning clothing, for easier ›navigation‹ through the Palaeolithic to Mesolithic record of human and anthropomorphic images, the table also provides a coarse-grained account of the cultural contexts of the individual depictions, as well as rough age approximations without targeting fine-chronological issues.

The overall paucity of Palaeolithic to Mesolithic imagery hinting at clothing can also be interpreted to mean that such depictions were not primarily intended to show how prehistoric humans dressed in their daily lives.

## Fully dressed?

The most famous representations of humans from the Palaeolithic era are three-dimensionally carved or sculpted figurines of the so-called Willendorf-style, often described as »Venus« figurines, dating to between roughly 35 ka and 16 ka[3] ago. By far, they most frequently depict females. Although they are generally shown more or less naked (Nowell/Chang 2014), some of these figurines may display attributes such as personal ornaments or ›clothing items‹ (in the broadest sense), which somehow ›tag‹ or personalise the depiction (Gaudzinski-Windheuser/Jöris 2015). The occasional representation of facial traits and frequently shown hairstyles similarly add to a ›personalisation‹ of these figures. In contrast, engraved images tend to be highly schematised. Humans may either be shown in profile, as is the case for the Late Magdalenian Gönnersdorf-type of (female) depictions (e.g. Jöris 2021; Gaudzinski-Windheuser/Jöris 2015; Bosinski et al. 2001), or as silhouettes, as in the case of some scenically-composed illustrations, all made on bone, from the Final Magdalenian contexts of Abri Raymonden at Chancelade, Abri du Châteaux at les Eyzies, Grotte de Gourdan, and a few other sites (Fig. 1), all located in France (Leroi Gourhan 1971; Duhard 1996; cf. Gaudzinski-Windheuser/Jöris 2015). Their highly schematised style of representation lacks almost every detail. However, the shapes of the anthropomorphic silhouettes could suggest that some type of tightly fitted, coat-like garment may have camouflaged or ›smoothed‹ the shape of the human body. Nevertheless, specific clothing items cannot be recognised in any of these depictions.

A notable difference is evident in a larger mid-Magdalenian depiction of a single human silhouette, engraved on a rib found at the site of Bruniquel, also in France (Leroi Gourhan 1965; Duhard 1993). Running vertically in a line down the middle of the figure's torso are six engraved circles that resemble buttons (Fig. 2)[4].

In the Grotta delle Incisioni all'Addaura in Sicily, Italy, a scenic composition of several engraved human figures, dated to around 14 000 years ago (Di Maida et al. 2020), has been interpreted as a dancing scene (Budano 2019). This scene, to which a few animal depictions were later added (Mussi et al. 2023), is especially noteworthy, as the combination of numerous human figures shown in different body postures and perspectives (Fig. 3) is probably unique in the record of Palaeolithic art throughout Eurasia[5]. In the context of clothing discussed here, it is important to highlight the shape of several of the human figures that appear to wear tailored garments, as indicated by engraved short ›belt‹-like lines, separating the upper and lower body (Budano 2019). Even lacking much detail, one may interpret these figures as representations of humans completely dressed in fitted clothes, some of whom – depicted in profile – appear to be hooded or wearing masks, if one follows Paola Budano's interpretation. Others may carry a sack/backpack, or spears[6].

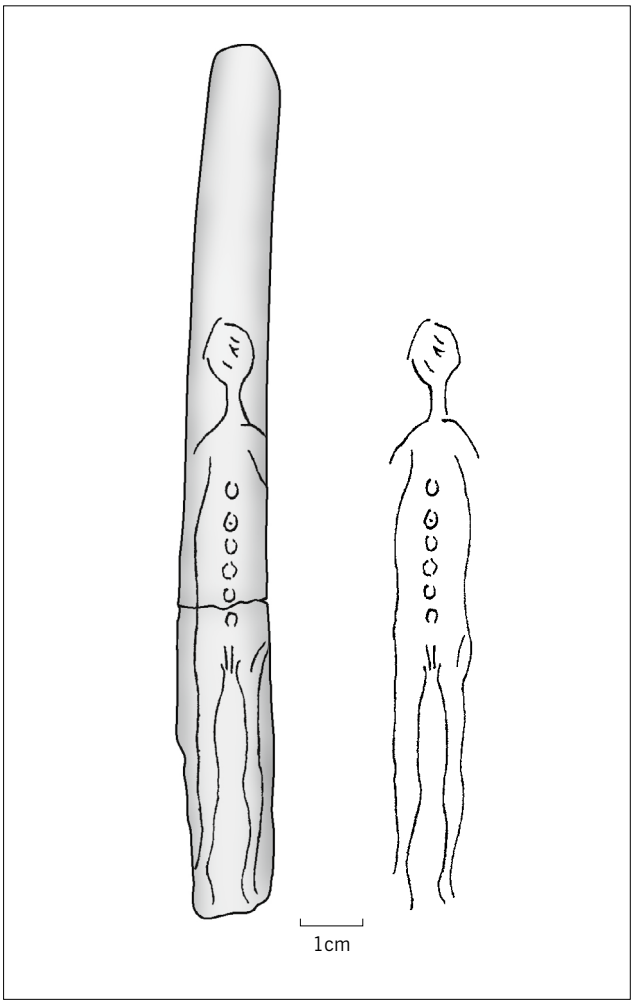



**Fig. 2** Engraving of a human silhouette from Bruniquel, Dép. Tarn-et-Garonne (France), with six button-like engraved circles arranged in a vertical line running down the figure's torso.

***Abb. 2*** *Gravur einer menschlichen Figur aus Bruniquel, Dép. Tarn-et-Garonne (Frankreich), mit sechs knopfartig gravierten Kreisen, die in einer vertikalen Linie entlang des Oberkörpers der Figur angeordnet sind.*

3 ka = kilo annum (i.e. 1000 years).

4 Button-like objects, so-called rondelles, are known from various Upper Palaeolithic contexts and are either made of bone, ivory, or stone (e.g. Bosinski 1977; Abramova 1995). They may have functioned as buttons or potentially used for other purposes, such as spindle whorls (cf. Needham et al. 2019).

5 A noticeable increase in depictions interpreted as dance scenes correlates with the beginning of the Neolithic (Garfinkel 2003).

6 Among the different authors, slight differences exist in the recognition and interpretation of individual engraved lines. As such, not all publications detect all of the ›belts‹.

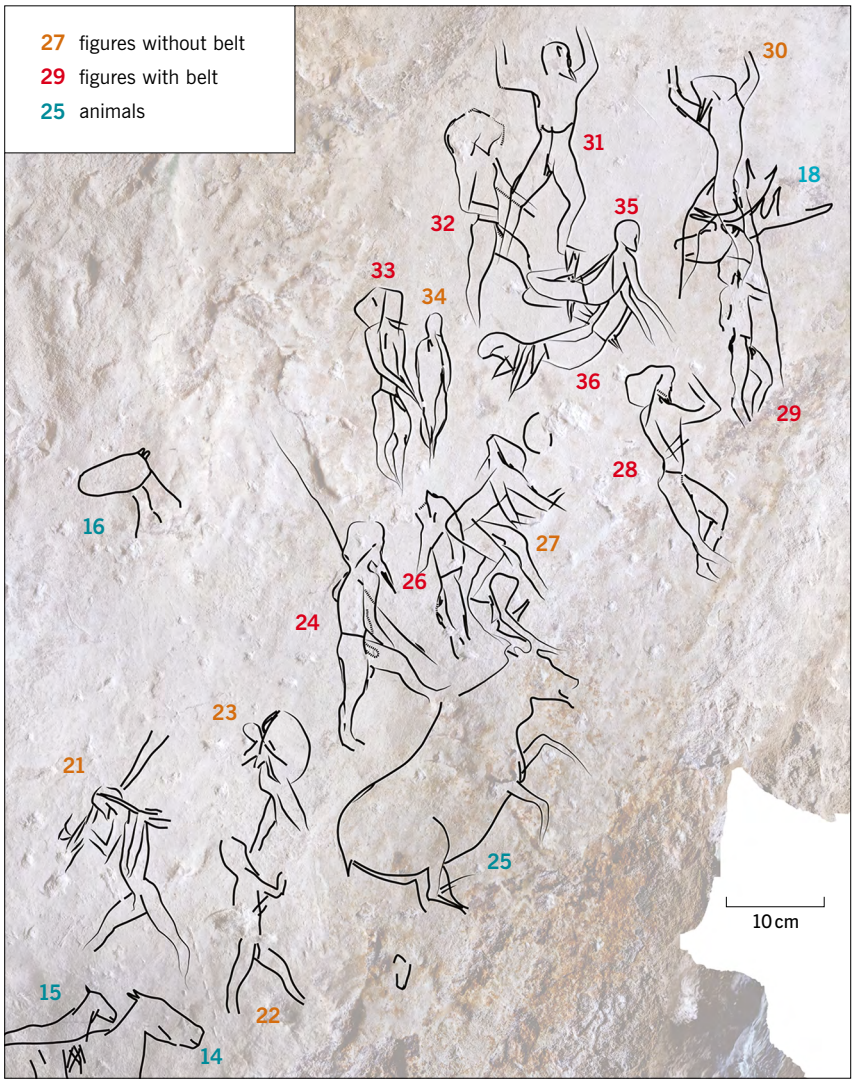



**Fig. 3** Late Palaeolithic scenic depictions of humans (red and orange numbers) at Grotta delle Incisioni all'Addaura, Prov. Palermo in Sicily, Italy, superimposed by engraved animals (blue numbers). Some of the human figures are shown in frontal view (orange numbers 30–31, 34), while others are in profile. Most of the human figures seem to wear ›belts‹ (red numbers: 24, 26, 28–29, 31–33, 35–36).

***Abb. 3*** *Spätpaläolithische szenische Darstellung von Menschen (rote und orangefarbene Zahlen) in der Grotta delle Incisioni all'Addaura, Prov. Palermo in Sizilien, Italien, überlagert von gravierten Tieren (blaue Zahlen). Einige der menschlichen Figuren sind in Frontalansicht dargestellt (orangefarbene Zahlen 30–31, 34), andere im Profil. Die meisten menschlichen Figuren scheinen ›Gürtel‹ zu tragen (rote Zahlen: 24, 26, 28–29, 31–33, 35–36).*

In contrast, two engraved pebbles, both found at open-air sites in the southern Netherlands, one at Wanssum, the other at Geldrop, depict humans in frontal view, both minimally dressed, but clearly wearing loincloths (Fig. 4; Verhart/d'Errico 2012; Niekus/Amkreutz 2021; Amkreutz/Niekus 2023). Whereas the Geldrop engraving is interpreted as a female dancing, the Wanssum figure is interpreted as a human in a throwing posture, likely male, considering the shape of the body and the absence of breasts (Verhart/d'Errico 2012). The Geldrop loincloth is triangular, fixed on a string, and filled in with oblique parallel lines running from the lower left to the upper right; it is also edged with short lines that seem to ›dangle‹ downwards. In contrast, the Wanssum loincloth is rectangular, not filled in, and fixed on two parallel strings. While directly associated archaeological material is lacking for Wanssum, the archaeological context of Geldrop suggests a Younger Dryas to early Holocene Ahrensburgian age (Bohmers/Wouters 1962). Compared with Epi-Palaeolithic art of southern France and Italy (cf. d'Errico 1994), a Late Glacial to early Holocene age for both finds appears most likely (Verhart/d'Errico 2012).

## Fully dressed!

The lack of detail in such depictions stands in stark contrast to some of the Upper Palaeolithic burial evidence, at least when considering some of the richly decorated graves of the mid-Upper Palaeolithic, such as Arene Candide and Ostuni 1 in Italy, Brno 2 in the Czech Republic, or Sunghir in Russia, to name a few (cf. Pettitt 2010). Most intriguing in this context are the extended burials of graves 1 and 2 at Sunghir (Trinkaus/Buzhilova 2018; cf. Bader 1978), which may be c. 30 000 to 34 000 years old (Sikora et al. 2017; see Kuzmin 2021 for critical remarks on the age of the Sunghir burials). In addition to other grave goods (Bader 1978; Rogačev/Anikovič 1984), numerous ivory beads, amounting to a total of more than 13 000 items, as well as hundreds of fox tooth pendants were found within the double burial (grave 2) of a juvenile (Sunghir 3) and an adolescent (Sunghir 2), both male, and in the single burial (grave 1) of a c. 35–45-year-old male (Sunghir 1; Sikora et al. 2017; Trinkaus/Buzhilova 2018). The largely symmetrical arrangements of these ornaments, namely the ivory beads (but also the fox tooth pendants) in clusters and lines along different parts of the

**Fig. 4a–b** Human figures engraved on pebbles from (a) Wanssum, Prov. Limburg, and (b) Geldrop, Prov. Noord-Brabant, both in the Netherlands.

***Abb. 4a–b*** *Auf Flussgeröllen gravierte menschliche Figuren aus (a) Wanssum, Prov. Limburg, und (b) Geldrop, Prov. Noord-Brabant, beide in den Niederlanden.*

bodies (Bader 1978; Trinkaus/Buzhilova 2018), indicate that most of the decorative items were sewn as applications onto clothing, whereas others were used as jewellery, such as armbands (Trinkaus/Buzhilova 2018). The Sunghir evidence points to elaborately tailored and fitted clothing that covered large parts of the body, allowing the reconstruction of ensembles that each consisted of varied clothing items, including ponchos or parkas and hoods, leggings-like trousers, and footwear. Given the richness of the decorative objects associated with each of the three individuals and the immense work involved in the production of such garments, one may assume that this type of dress was unlikely to have been used in daily activities, but rather in ceremonial contexts or for the specific purpose of burial, supporting the construction of social identities (White 1999; cf. Collins/Nowell 2024). Given the sheer amount of the small-sized ivory beads, one may assume they were applied to a ›cloth‹ with a relatively homogeneous surface, in order to enhance visibility and visual effects such as colour contrasts. Most likely, tanned animal skins or hides bare of visually distracting structured surfaces would have served as an unobtrusive background, thus putting the decorative items into focus.

In contrast to these findings, artistic depictions of fully dressed humans are scarce in the Palaeolithic of Eurasia. The most compelling evidence comes from a number of ivory human figurines, generally interpreted as female, unearthed at the Siberian sites of Mal'ta and Buret' in

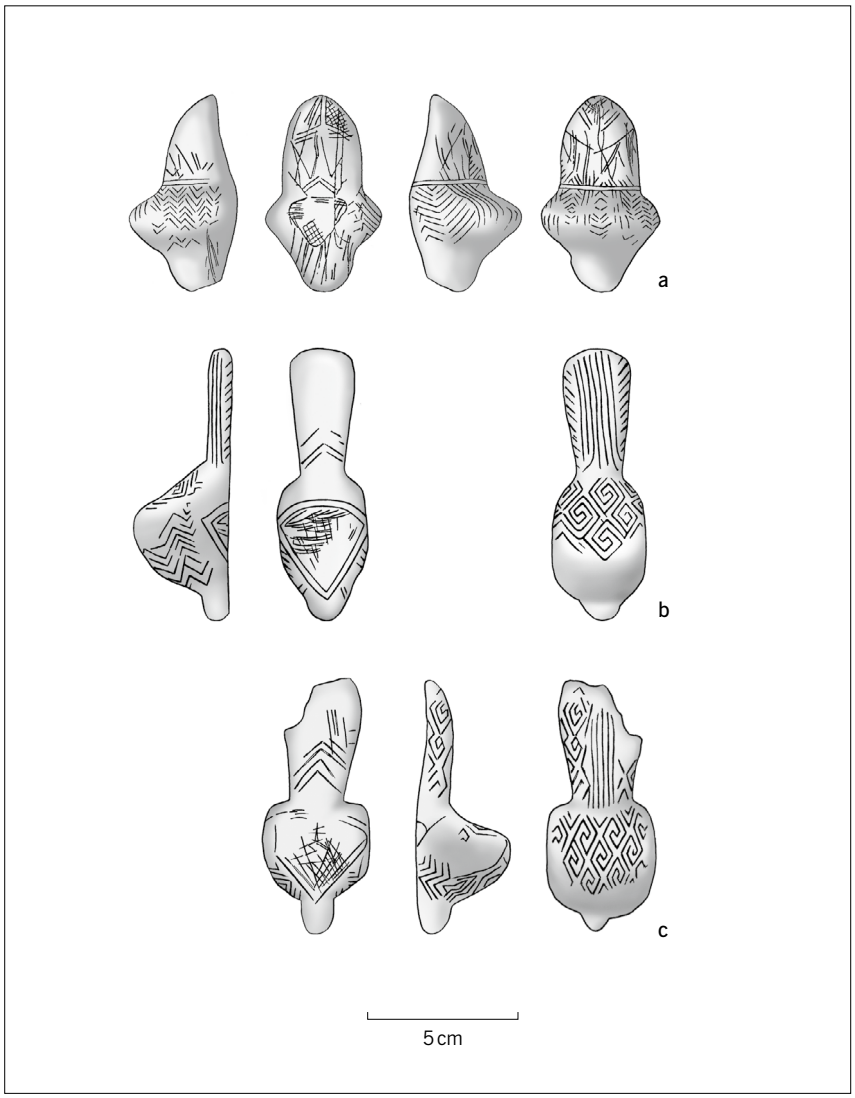



**Fig. 5a–c** Headless anthropomorphic ivory figurines, interpreted as female, from dwelling 2 (a) and dwelling 3 (b–c) of the site of Mezin, Obl. Tschernihiw (Ukraine).

***Abb. 5a–c*** *Kopflose anthropomorphe Elfenbeinfiguren, die als weiblich interpretiert werden, aus Behausung 2 (a) und Behausung 3 (b–c) der Fundstelle Mezin, Obl. Tschernihiw (Ukraine).*

Russia (Abramova 1995 for an overview; cf. Delporte 1979; Lbova 2021). Both sites date near to or in the Last Glacial Maximum, some 19–23 ka ago (Mix et al. 2001). Besides several clearly female ivory figurines, at both sites a few other ivory figures were found that do not display breasts. These specimens are hooded and completely covered with regular symmetrical deeply-carved patterns. The two patterns that can be distinguished are (1) composed of deep half-moon shaped or rounded carvings or punch marks, or (2) display multiple horizontal, subparallel lines, which give the impression of the figures being completely wrapped in some sort of garment. Whereas the first type is present at Buret' (Abramova 1995, Cat. 90,1) and Mal'ta (Abramova 1995, Cat. 89,3), the latter is documented only at Mal'ta (Abramova 1995, Cat. 89,13; Cat. 89,16; Cat. 89,27). While one might be tempted to interpret these figures as potentially male, given the absence of breasts and the size of the Buret' figure, entirely covered in hooded clothing, Ludmilla Lbova (2021) views the whole-body-covering (wrapping) ornaments of the Mal'ta specimens as a kind of protection for young individuals, namely children. The latter interpretation is supported by the small size of these figurines and the preservation of reddish pigments on some (e.g. Abramova 1995, Cat. 89,27: »teenage girl«: Lbova 2019; Lbova/Volkov 2017), which could be interpreted in relation to female sexual maturation. This interpretation, however, leaves unanswered the question of whether the patterns are simply ornamental or intended to resemble fully dressed bodies – the hoods, at least, would speak in favour of the latter.

Most of the clearly female figurines from the two sites are characterised by their overall womanly body shape and the depiction of breasts (Abramova 1995 for an overview). However, contrasting the mid-Upper Palaeolithic Willendorf-style female images found further west in Europe (Gaudzinski-Windheuser/Jöris 2015; Farbenstein 2017), the Mal'ta and Buret' specimens show less voluptuous bodies and a ›smoothed‹ body relief with less protuberant breasts or buttocks (Tab. 1). Together with the frequent depiction of ornamented hoods, this shape may hint at completely covered, tightly wrapped bodies, giving the impression of the thick, well-fitted clothing often interpreted as necessary for survival in the cold climate of the Siberian arctic (e.g. Delporte 1993).

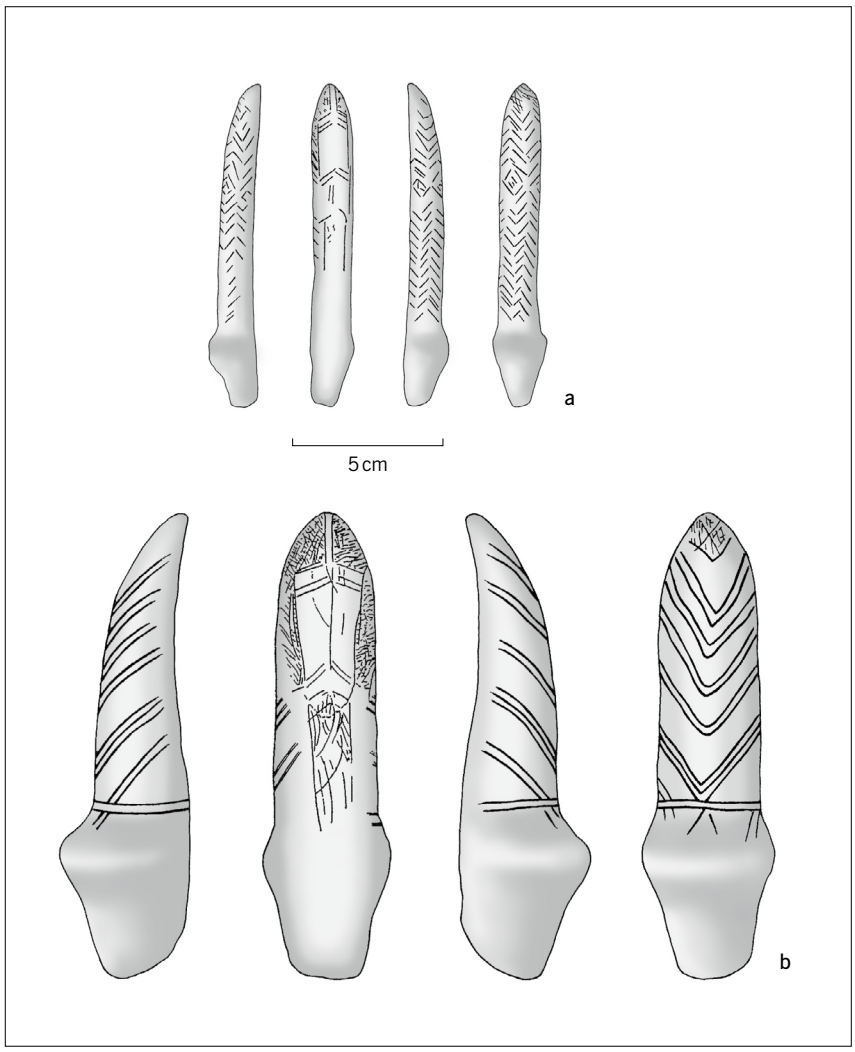



**Fig. 6a–b** Headless anthropomorphic ivory figurines, interpreted as male, from dwelling 2 of the site of Mezin, Obl. Tschernihiw (Ukraine).

***Abb. 6a–b*** *Kopflose anthropomorphe Elfenbeinfiguren, die als männlich interpretiert werden, aus Behausung 2 der Fundstelle Mezin, Obl. Tschernihiw (Ukraine).*

**Fig. 7** Gönnersdorf, Neuwied District (Germany). Headless anthropomorphic engravings of four hatched figures of Gönnersdorf-type, all oriented to the right. Note: the third figure from the left seems to carry a smaller figure on its back.

***Abb. 7*** *Gönnersdorf, Lkr. Neuwied (Deutschland). Kopflose anthropomorphe Gravuren von vier schraffierten Figuren vom Gönnersdorf-Typ, die alle nach rechts gewandt sind. Anmerkung: Die dritte Figur von links scheint eine kleinere Figur auf dem Rücken zu tragen.*

**Fig. 8a–b** Anthropomorphic depictions (a) on an engraved pebble from Valkenburg-Straatbeek, Prov. Limburg (the Netherlands), and (b) on an ornamented aurochs metapodial found at Ryemarksgård, Zealand (Denmark).

***Abb. 8a–b*** *Anthropomorphe Darstellungen (a) auf einem gravierten Flussgeröll aus Valkenburg-Straatbeek, Prov. Limburg (Niederlande), und (b) auf einem verzierten Metapodium eines Auerochsen, gefunden in Ryemarksgård, Seeland (Dänemark).*

## Pelts?

The hoods depicted at Mal'ta and Buret' are predominantly ornamented as in pattern 1 described above. If this type of carving, which is similar to patterns created when ›punching‹ leather (Doyon et al. 2023), is interpreted along the lines of arguments outlined in the introduction of this volume for an Aurignacian ivory sculpture of a cave lion from the southern German site of Vogelherd Cave, one may consider that the hoods were possibly made chiefly from the pelts of fur-bearing animals.

The small Aurignacian ivory sculpture of an upright standing anthropomorph with raised arms, known as »the Adorant« (see Fig. 11 of Wolf/Conard in this volume), found at Geißenklösterle Cave, also in southern Germany, displays just such a regular ›punched‹ pattern on the reverse side of the bas-relief (Hahn 1982; cf. Floss 2015). In an alternative reading, one could interpret this figure as a person covered with the pelt of a fur-bearing animal (a carnivore?), similar to the interpretation of the famous Lion-Man ivory sculpture from the Aurignacian of Hohlenstein-Stadel, also in southern Germany (cf. Kind et al. 2014). In this interpretation, the »elongated appendage« between the Adorant's feet (Wolf/Conard in this volume), which has been interpreted as the tail of an animal (Hahn 1986), would make good sense. Following this line of argument, one would interpret the Adorant alongside other depictions that have frequently been construed in the context of disguise and/or the realm of human-animal mixed beings (cf. Pettitt 2017). The Late to Final Magdalenian French cave sites of Gabillou and Trois-Frères have both produced rock art engravings understood to represent persons with bison heads and a human lower body, covered in animal skins[7], as well as mixed beings composed of the attributes of entirely different animals on a human lower body (»Dieu Cornu« at Les Trois-Frères: Breuil 1952)[8].

7 Leroi-Gourhan 1971; Bégouën/Breuil 1958; cf. Duhard 1996; Fuentes et al. 2019.

8 These depictions are often viewed in the context of prehistoric shamanism (Lorblanchet 1995) and may hint at a close connection to and a permeability between the human and animal spheres (cf. Conneller 2004; see also Hussain in this volume), but caution is advised when using (or overstretching) modern ethnographic analogies (e.g. Lewis-William 1991; Petru 2012; Půtová 2013; cf. Guthrie 2005).

**Fig. 9a–b** Tall anthropomorphic depictions (a) on an amber pendant from Sindalgård, Åmosen, and (b) on a perforated and ornamented red deer antler shaft from Veksø Mose, Zealand, both found in Denmark.

***Abb. 9a–b*** *Schmale anthropomorphe Darstellungen (a) auf einem Bernsteinanhänger aus Sindalgård, Åmosen, und (b) auf einem perforierten und verzierten Rothirschgeweihschaft aus Veksø Mose, Seeland, beide gefunden in Dänemark.*

## Body painting, tattoos, or textiles?

Whereas the above discussions largely address the use of animal materials for clothing, some of the more schematic anthropomorphic depictions are covered by or filled with more or less geometric patterns.

The headless anthropomorphic ivory figurines found at the Epigravettian site of Mezin in Ukraine are ornamented with geometric patterns that cover the figurines' backs and sides (Chovkoplass 1965; Iakovleva 2009; Iakovleva 2015). Based on their morphology and style of ornamentation, female (Fig. 5) and male figures (Fig. 6) may be distinguished (Jöris 2021; cf. Chovkoplass 1965). Engraved chevrons and zig-zag lines are the basic elements of the geometric patterns, which are combined in different arrangements, whereas the female depictions from Mezin dwelling 3 (Fig. 5b–c) are also ornamented with patterns of ›angular meanders‹ (Jöris 2021). The patterns that cover large parts of the figurines were either of a simple ornamental nature, represented body painting, tattoos, or could hint at patterns realised in cloth. Similar or identical geometric patterns are often seen in Eastern European Epigravettian artworks and jewellery (Chovkoplass 1965; cf. Abramova 1995 for an overview).

As has already been addressed above, even more schematic human depictions appear with increasing frequency in the later periods of the Eurasian Palaeolithic and Mesolithic, postdating c. 16.5 ka cal BP (Jöris 2021). An exceptional engraved shist plaquette (#87) found at the Late Magdalenian site of Gönnersdorf in the central Rhineland of Germany displays four headless female figures of the Gönnersdorf-type and a ›baby‹ carried on the back of the third female from the left (Fig. 7; Jöris 2021; Gaudzinski-Windheuser/Jöris 2015; Bosinski et al. 2001). Each of the figures is covered by a geometric pattern composed of hatched and/or cross-hatched lines[9]. Here, one can ask the same questions as in the case of Mezin, discussed above. What do such patterns mean? Were they simply ornamental, or do such patterns refer to body painting, tattooing, or patterned clothes?

9 The Late Magdalenian site of Andernach-Martinsberg in Germany, located near the site of Gönnersdorf, produced a large ivory statuette of ›Gönnersdof-type‹. Engraved on the figure's right side, pairs of angular lines form chevrons that resemble, to some degree, the patterns on some Mezin statuettes (Veil 1982).

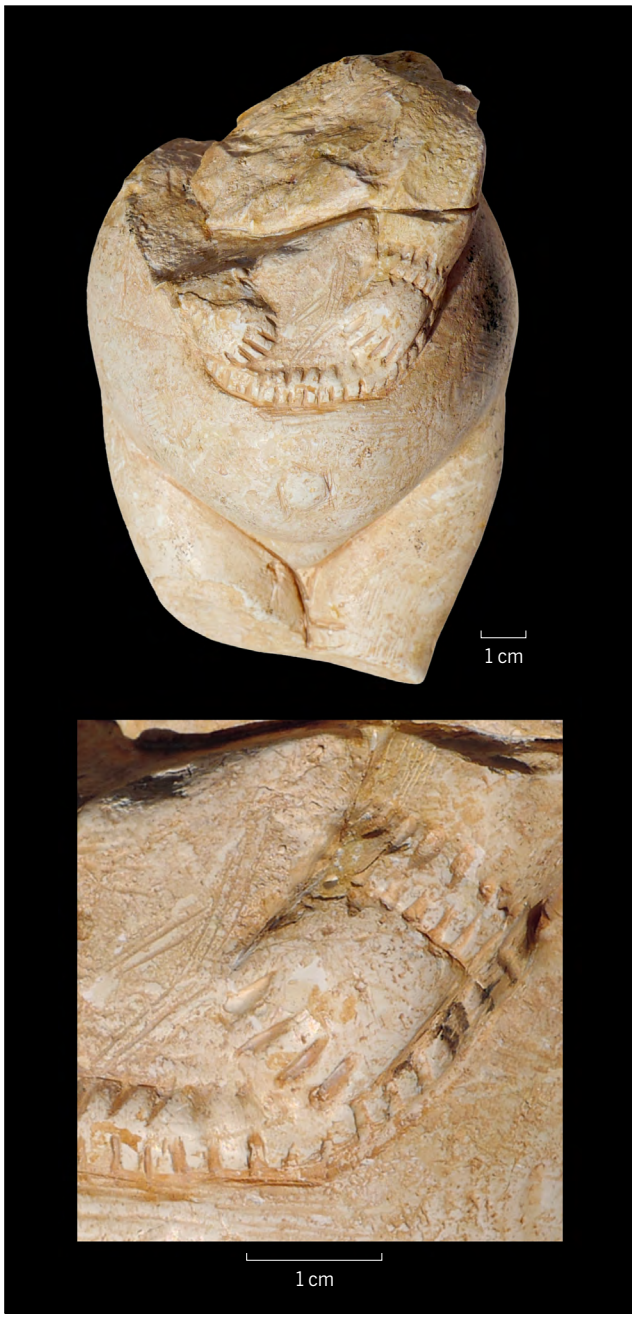



**Fig. 10** Female marlstone figurine from Kostenki 1, Obl. Woronesch (Russia), displaying ›manacles‹.

***Abb. 10*** *Weibliche Figurine aus Mergelstein aus Kostenki 1, Obl. Woronesch (Russland), mit ›Handschellen‹.*

If one assumes that the hatching and cross-hatching patterns were deliberately and purposefully made, which can be argued given that the plaquette is unique compared to the hundreds of schematic female depictions known from the site as well as from across western and central Europe (Bosinski et al. 2001; Gaudzinski-Windheuser/Jöris 2015; Jöris 2021), then one may focus attention on some pattern details. Cross-hatching is located especially around the figures' hips, creating smaller pattern cells. Furthermore, the cells are flatter due to reduced distances between the horizontal lines when compared with the cells of the upper body above the waist. In contrast, the cells are much higher – at least in figures two and three from the left (see Fig. 7) – in the lower body around the buttocks. Although proof is lacking, one is tempted to interpret this pattern as showing how a lightweight (woven?) dress falls and folds on the female body, stretching across the buttocks. However, besides the fragmented engraved Gönnersdorf plaquette #6, which displays another hatch-filled female figure, no further finds with such a type of ornamentation are known. Nevertheless, as has been claimed repeatedly[10], the processing of plant fibres in the production of (lightweight) clothes may have played a much more important role in the Palaeolithic than is generally assumed (cf. Jöris in this volume).

Even though anthropomorphic/human depictions occur more rarely in Mesolithic contexts, they tend to be highly schematic and are also filled with geometric patterns (Fig. 8–9). In fact, it seems to become standard in the Mesolithic that anthropomorphs are filled with patterns. They are mostly found on tools or pendants (Solfeldt 2023). The few specimens known all come from the northern parts of Europe, primarily from Denmark (e.g. Brinch Petersen/Toft 2023; Sørensen 2023; Petersen 2024) and the Netherlands (Amkreutz/Niekus 2023). Whenever contextual archaeological data are available, these finds are assigned to the Early Mesolithic Maglemosian (Brinch Petersen/Toft 2023; Sørensen 2023). Even though small in number (Tab. 1), the few anthropomorphic depictions known today can be separated into two groups: (1) short and (2) tall anthropomorphs. Whereas group 1 anthropomorphs display triangular heads shaped like fishtails and are either filled by fishbone or cross-hatched patterns (Fig. 8), group 2 representations are slimmer, tall, and display more or less diamond-shaped heads; these figures are filled either with patterns of series of parallel oblique lines, cross-hatched lines, or – in one case – with short lines running from the figure's outline inwards (Fig. 9). The latter pattern, which characterises the left of two figures engraved on a perforated antler artefact from Veksø Mose in Denmark (Sørensen 2023), closely resembles two figures from mid- and Final Magdalenien or Azilian contexts of Laugerie Basse and Mas-d'Azil in southern France (cf. Duhard 1996, Fig. 67; 70). Although one may interpret the two different patterns of the northern Mesolithic in relation to clothing, analogous to the case of Gönnersdorf with the arguments presented above, in these instances, one must ask whether the depicted patterns relate to clothing at all, especially as such patterns appear quite frequently across the (northern) Mesolithic of Europe (Płonka 2003). The difficulty of interpreting abstract art is inherent to this topic, and – alternatively – one may link the ›fishbone‹ and ›fishing net‹ patterns in these contexts to significant changes in subsistence strategies which, from the Pleistocene-Holocene transition onward, rely increasingly on the exploitation of aquatic resources (cf. Matthiassen 1941; Fischer/Myrhøj 1995).

10 E.g. Adovasio et al. 1996; Soffer 2004; Soffer/Adovasio 2010; Soffer/Adovasio 2014; Soffer et al. 1998; Soffer et al. 2000.

**Fig. 11** Female marlstone figurine from Kostenki 1, complex 2, Obl. Woronesch (Russia). The figure is decorated with a brassiere-like breastband, and with one armlet and one wristband on each side.

***Abb. 11*** *Weibliche Figur aus Mergelstein aus Kostenki 1, Komplex 2, Obl. Woronesch (Russland). Die Figur ist mit einem Büstenhalter-ähnlichen Brustband sowie einem Armband und einem Handgelenkband auf jeder Seite verziert.*

## Fibre-based clothing technologies

In addition to some geometric patterns that can be interpreted to represent textiles, and which tend to date later than c. 16 ka cal BP, the mid-Upper Palaeolithic record of Willendorf-style depictions includes some detailed images of fibre-based clothing items. Most intriguing are the ›manacles‹ crossing the belly of a large female figurine from Kostenki I in Russia (Fig. 10; Praslov 1993), made of marlstone. Connecting both wrists, the ›manacles‹ are worked plastically in a way that makes their rope-like structure clearly visible. It is also apparent that the details of the rope's structure are not simple decorative elements. Instead, this detail was modelled purposefully to reveal both what was depicted and what the ›manacles‹ were made of (whatever their original meaning). Identical structural details are depicted on a brassiere-like breastband that sits above the breasts of another female marlstone figurine from Kostenki I (Fig. 11; Praslov 1985; Praslov 1986). The ›rope‹ continues along the back of the figure and is fixed around the neck. Very similar details have been observed on fragments of anthropomorphic figures from the early mid-Upper Palaeolithic site of Pavlov in the Czech Republic (Verpoorte 2000; cf. Delporte 1993). Here, ropes have been modelled three-dimensionally in clay that was subsequently fired. Although the fired clay figures are heavily fragmented, it is clear that some display ropes or cords that passed around the middle of the body (in one case below the buttocks) or around the neck (Tab. 1). The detailed depictions show that the ropes were made of twisted (plant) fibres, as was a rope fragment preserved, carbonised, in the Lascaux cave in France (Leroi-Gourhan 1982)[11].

As ropes are twisted cords, cords are twisted threads, and threads are twisted fibres, this evidence opens up a complete spectrum of fibre-based textile technologies. Indeed, imprints of cords in fired clay have been reported from a few eastern European mid-Upper Palaeolithic sites (Adovasio et al. 1996; Soffer et al. 2000), and the production of thread by twisting fibres is indicated from around the Last Glacial Maximum (Nadel et al. 1994)[12].

Other, simpler, breastbands that run horizontally above the breasts are documented on a few other female figurines (Tab. 1). Noteworthy are two very similar ones, both from Kostenki I, and a third specimen from Avdeevo, also Russia, all made in ivory (Abramova 1995, Cat. 42,1; Cat. 42,163; Cat. 36,36). A fourth depiction of such a breastband has

11 Experimental data indicate that instruments suitable for rope making had been in use at least since the Aurignacian (Conard/Rots 2024).

12 See Nadel 2003 for an updated age estimate of the evidence.

**Fig. 12** Female ivory figurine from Kostenki 1, Obl. Woronesch (Russia), with an engraved breastband, depicted in detail.

***Abb. 12*** *Weibliche Elfenbeinfigur aus Kostenki 1, Obl. Woronesch (Russland), mit graviertem Brustband, im Detail dargestellt.*

been realised in an engraving of a female on a marlstone plaquette (Abramova 1995, Cat. 42,53). The specimen Cat. 42,1 (Fig. 12) from Kostenki shows an engraved breastband that is separated into two levels and hatched by short parallel oblique lines. The band continues on the figure's back, although it is worked in less detail. Such breastbands seem to be a characteristic feature of the eastern European mid-Upper Palaeolithic.

Other depictions, related to potential plant-fibre work, may represent hairnets. Probably the most unmistakable evidence for the use of such headgear comes from the two mid-Upper Palaeolithic contexts of Brassempouy in France (Piette 1895) and Balzi Rossi (Grimaldi; Mussi et al. 2000) in Italy (Fig. 13). The sculptures of interest here are fragmented; only their heads are preserved. Even though different materials were chosen at the two sites – ivory in the first case and steatite, a soft stone, in the second – regular cross-hatched patterns were carefully and deeply carved into the processed materials, creating the net-like impression. One must assume – given the great care apparently involved in carving the two heads – that the regularity of the pattern was intended to depict a hairnet rather than schematic hair. For the same reasons, one would assume that the »Willendorf Venus« (Antl-Weiser 2008a; Antl-Weiser 2008b), found in 1908 in Lower Austria, and the »Femme à la tête quadrillée«, a bas-relief depiction from Laussel in France (Delporte 1993), both dating into the mid-Upper Palaeolithic, wore hairnets. Alternatively, one may interpret these as caps onto which personal ornaments had been sewn, covering their entirety. The existence of such well-decorated caps is implied from mid-Upper Palaeolithic burial contexts (e.g. Pettitt 2010; cf. Coste/Giacobini in this volume).

In many other cases, however, when less regular patterns decorate the heads of Willendorf-style depictions, it is difficult to say whether hairnets, hoods, or caps are represented; if hair is being shown schematically, the patterns applied could simply indicate curly hair (Tab. 1).

## Potential clothing accessories

Some indeterminate clothing items appear in varying frequencies on Willendorf-style depictions (cf. Gaudzinski-Windheuser/Jöris 2015). In many cases, it is unclear exactly what is depicted, either because of the stage of weathering or due to the reduced style of representation in which some details may be implied by adding only a few lines. The contrary may also be the case, i.e. when too many lines ›overprint‹ and potentially ›hide‹ other graphic details. In engravings, such as those of La Marche in France (Pales/Tassin de Saint Péreuse 1976), this can easily be the case, for example, when a hairdo is depicted. As such, it is sometimes unclear whether hoods or caps are represented, as they may be hidden under lines illustrating hair. This difficulty applies similarly to figurines when hoods or hairstyles are carved in a plastic manner. A schematic three-dimensionally sculpted bob-like hairstyle cannot easily be distinguished from a carved hood.

Nevertheless, even if a clear distinction between headgear and hairstyles is often rendered difficult[13], it is still notable that hoods are by far the most frequent clothing items featured in Willendorf-style depictions – especially when looking at eastern European and Siberian figurines (Abramova 1995; Mussi et al. 2000). The indications for

13 Several of the Willendorf-style depictions represent details of hairstyles (e.g. Gaudzinski-Windheuser/Jöris 2015 for a few examples). In the context of hairstyle variability, one can easily imagine that the four holes pressed vertically into the clay heads of two figurines from Dolní Věstonice in the Czech Republic (Verpoorte 2000; cf. Neruda et al. 2024) were originally filled with materials such as feathers or real hair – probably to personalise the figurines. A rope-like ornament on the right side of the chest of a female ivory figurine from Mal'ta in Siberia (Abramova 1995, Cat 89,23) seems to start at the head and may represent a ponytail hairstyle.

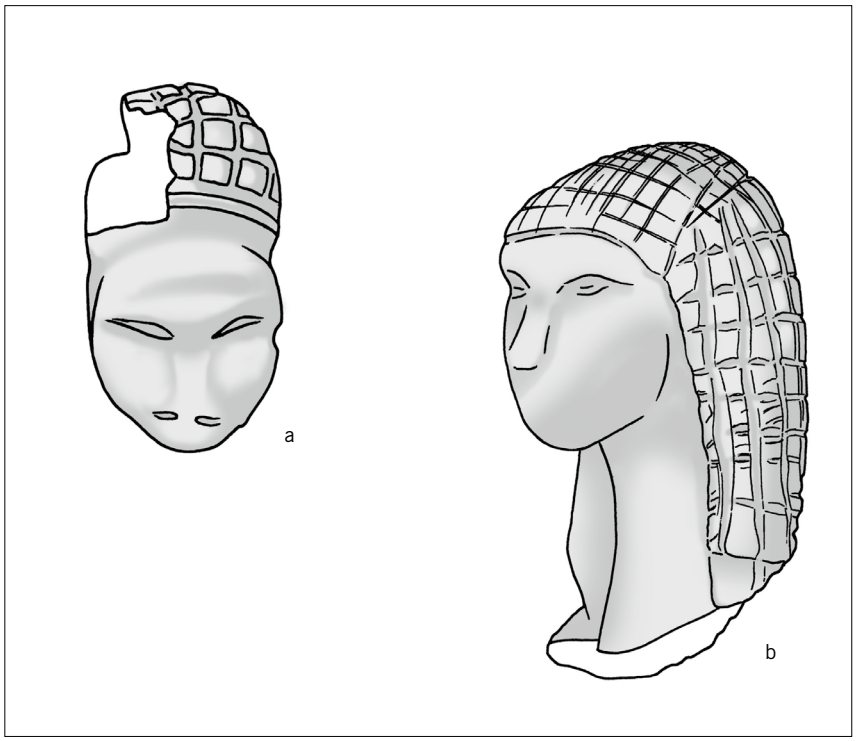



**Fig. 13a–b** Willendorf-style figurine faces with hairnets, from (a) Balzi Rossi, Grimaldi, Prov. Imperia in Italy (»The Negroid Head«) and (b) Brassempouy, Dép. Landes, France (»Dame à la Capuche«). Not to scale, but adjusted to a similar head size for better comparability.

***Abb. 13a–b** Gesichter mit Haarnetzen von Figuren im Willendorf-Stil, aus (a) Balzi Rossi, Grimaldi, Prov. Imperia in Italien (»The Negroid Head«) und (b) Brassempouy, Dép. Landes, Frankreich (»Dame à la Capuche«). Nicht maßstabsgetreu, aber zur besseren Vergleichbarkeit auf eine ähnliche Kopfgröße angepasst.*

potential pelt hoods have already been discussed above. Besides hoods, caps may also be shown in a few cases. Again, this accounts for some eastern European mid-Upper Palaeolithic finds (Abramova 1995) but also some of the La Marche engravings (Tab. 1). The so-called ›observation no. 29‹ of La Marche displays a head band (Fig. 14f; Pales/Tassin de Saint Péreuse 1976).

Moving farther down the body, breastbands, most likely made of fibres, have already been described, and belts around the hips were previously discussed in relation to tailored and fitted clothing. In fact, lines that separate the upper from the lower body are frequently found; however, they are mostly one single line or only a few short lines (Tab. 1). Noteworthy are a somewhat broader belt, sculpted on one of the bas-reliefs from Laussel in France (»Chasseur«; Delporte 1993), and the engraved broad belt of ›observation no. 49‹ from La Marche (Pales/Tassin de Saint Péreuse 1976). The latter is filled with a cross-hatched pattern, possibly indicating a large woven (?) piece of cloth used as a belt.

Some of the potential belts, marked by a horizontal carving, sit somewhat lower – even below the buttocks – such as the ropes mentioned above, or as indicated by a deeper carving on Venus I of Dolní Věstonice in the Czech Republic (Verpoorte 2000; cf. Neruda et al. 2024). This is the position where the ›shroud‹ begins, shown on the back of the Lespugue Venus from southern France; from there, it runs down the body to the feet (de Saint-Périer 1922). Several subparallel lines filling the ›shroud‹ may indicate narrow folds in a textile cloth. In one of the interpretations of ›observation no. 29‹ from La Marche, some vertical lines below the buttocks may resemble such a shroud (Fig. 14d; Pales/Tassin de Saint Péreuse 1976). In this case, however, the engraved lines run upwards towards the buttocks.

## Jewellery

Jewellery is also occasionally found in Palaeolithic depictions (Tab. 1) which are discussed here from the top of the body to the feet. Necklaces may be draped around the neck, as in the case of a Magdalenian engraving on a bone found at Isturitz in southern France (Fig. 14b; Delporte 1993; Duhard 1993; Duhard 1996). The ornamental rope around the neck of a fragment of a fired clay figurine from Pavlov has already been mentioned (Verpoorte 2000; cf. Delporte 1993). An exceptionally detailed engraving of a necklace adorns an ivory figurine from Kostenki I (Abramova 1995, Cat. 42,2; cf. Delporte 1993). Depictions of armbands occur quite frequently (e.g. Fig. 14a–e), but sleeve holder like armlets (e.g. Fig. 11) and anklets (e.g. Fig. 14b; cf. Gaudzinski-Windheuser/Jöris 2015) are also known.

As the examples demonstrate, jewellery can be found on both sculpted figurines and in engraved images; personal ornaments appear in both the Middle and the Late Upper Palaeolithic periods, and are linked to eastern and western European sites, respectively.

## Discussion and conclusions

The Eurasian Palaeolithic to Mesolithic artistic record of clothing shows a three-stage chronological sequence of human and anthropomorphic depictions represented in different styles: The Willendorf-style of depiction (1) is characterised as more naturalistic, whereas the succeeding, far more abstract and highly schematised style of later Late Upper Palaeolithic depictions (i.e. post-dating c. 16.5 ka cal BP) comprises (2) Gönnersdorf-type- and silhouette-like anthropomorphic figures (Gaudzinski-Windheuser/Jöris 2015).

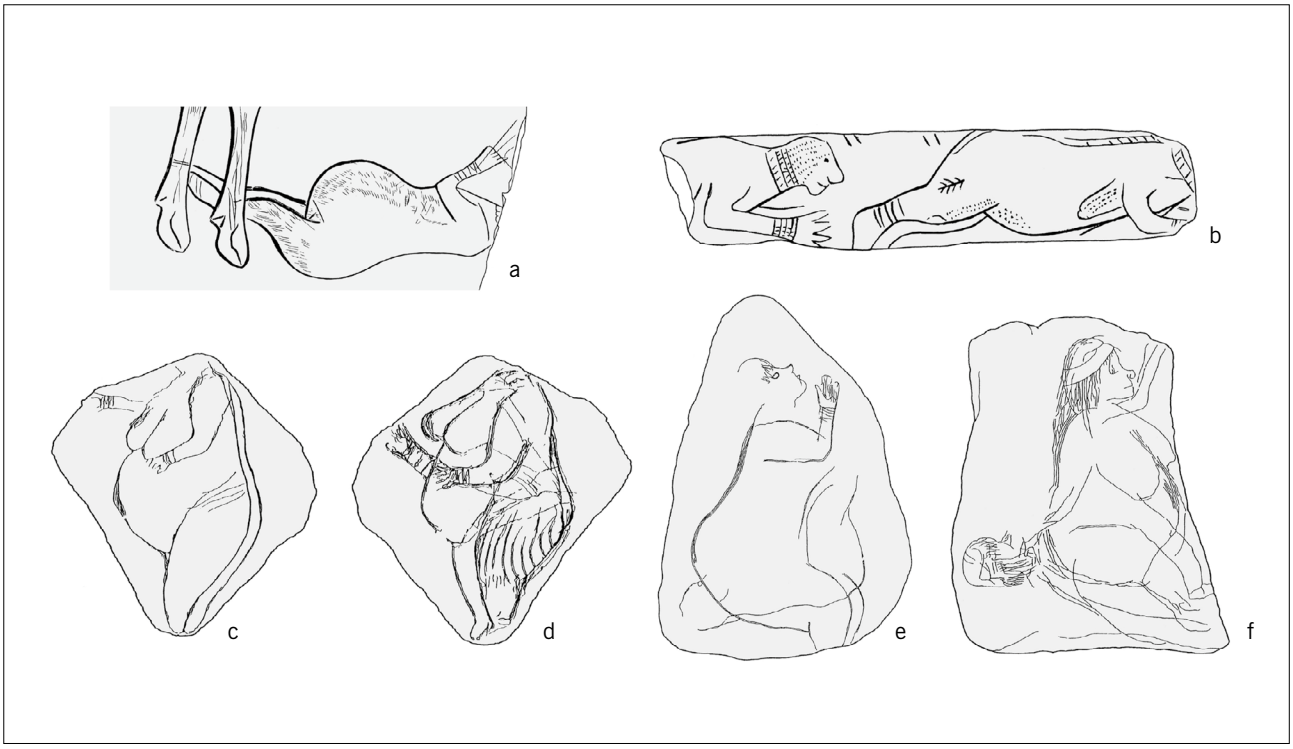



**Fig. 14a–f** Middle and Late Magdalenian female depictions from the French sites of (a) Laugerie-Basse, Dép. Dordogne, (b) Isturitz, Dép. Pyrénées-Atlantiques, and (c–f) La Marche, Dép. Nièvre. Not to scale, but adjusted to similar torso size for better comparability.

***Abb. 14a–f*** *Darstellungen von Frauen aus dem mittleren und späten Magdalénien aus den französischen Fundstellen (a) Laugerie-Basse, Dép. Dordogne, (b) Isturitz, Dép. Pyrénées-Atlantiques, und (c–f) La Marche , Dép. Nièvre. Nicht maßstabsgetreu, aber zur besseren Vergleichbarkeit auf ähnliche Torso-Größen angepasst.*

Between the Late Upper Palaeolithic and the Mesolithic, Europe experiences a major iconographic shift towards the (3) geometric-dominated art that characterises most of the European Mesolithic (Płonka 2003; Grünberg et al. 2023). This very coarse periodisation is well-reflected in the ways that clothing and body decoration are represented in the artistic record of the three stylistic epochs.

Whereas some of the Willendorf-style human and anthropomorphic depictions appear personalised through either the highlighting of facial details, hairstyles, personal ornamentation or clothing items, the later Late Upper Palaeolithic anthropomorphic depictions mostly lack any individual markers. The different demographic context and implications for social organisation have been discussed elsewhere in more detail (Gaudzinski-Windheuser/Jöris 2015). Here, only some key iconographic aspects underlying the stylistic differences between the first two epochs are mentioned. In reference to the Willendorf-style, it is worth noting that the iconographic elements added to the basic shape of the depictions are extremely unevenly dispersed and rarely combined with other iconographic elements on the same figurine. In other words, there seem to be no clear rules for where on a specific figure a detail should be added. On the contrary, the ›irregular‹ spatial distribution of details displayed on the figures' bodies points towards an emphasis on individuals who really existed. As such, Willendorf-style figurines may be considered historical sources for clothing, hairstyle and body ornamentation, highlighting features and attributes of particular individuals. This also implies that, whatever items were depicted that may relate to clothing in the broadest sense, this was not primarily done to illustrate how Palaeolithic people dressed but to ›tag‹ (and ›name‹) the individual on the one hand and to highlight the specific clothing item on the other. This explains why some items, e.g. the ropes, are depicted in such great detail. When social identities are partly rooted in descent and explained through kin, it would not be surprising if ancestral individuals were given names and tags, such as by the application of decorative or meaning-loaded items and related stories (which, in the ethnographic record, often also relate to metaphysical worldviews): this is what remembrance was always built upon in the pre-photographic period. The personal ornaments and clothing items depicted seem to have played central roles in this context. It is also important to emphasise that the majority of iconographic details are likely linked to decorative items made from plant fibre, as has been discussed in detail above. Besides the depicted clothing items themselves, thin twined fibre thread was the basic material required for both sewing and, most likely, also for producing jewellery.

Whereas the Willendorf-style period has such a strong focus on past individuals, the later Late Upper Palaeolithic, with its anthropomorphic images (Gönnersdorf-type and silhouette-like anthropomorphic figures), seems to focus more intensely on the social roles of individuals (Gaudzinski-Windheuser/Jöris 2015). However, the major ›iconoclasm‹ that led to the geometric-dominated art of the European Mesolithic may be best explained not only through the spread of new metaphysical concepts, which surely came in tandem with significant changes in social organisation, but

also through a major population turnover during the Late Glacial period that effected large parts of Europe (cf. Poost et al. 2023). A certain demographic and genetic continuity in parts of southwestern Europe that would have bridged the Last Glacial Maximum (Villalba-Mouco at al. 2023) could, if confirmed, also provide a theoretical demographic framework potentially suited to explaining the developments that may have led to the formation of the region-specific Levantine rock art (see footnote 2).

## Acknowledgements

The present paper builds on research undertaken at the MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution at Schloß Monrepos near Neuwied, a research location of the Leibniz-Zentrum für Archäologie (LEIZA), Mainz (Germany), in connection with the major research topic of understanding the role of rules and regulations in Palaeolithic and Mesolithic societies. My sincere thanks go to Gabi Rutkowski (†) and Nicole Viehöver, both MONREPOS, for substantial support in the production of most of the figures, and to Birte Janzen and Aniela Schuchardt, both LDA, for figures 3, 4, 8, and 9, and for clearing up copyright questions. I further thank Oliver Dietrich, LDA, for providing valuable hints on some references and Carola Murray-Seegert, Oberursel, and Manuela Schwarz, LDA, for the careful proofreading and improvement of the original manuscript.

**Tab. 1 (on the following pages)** Palaeolithic and Mesolithic art record of clothing. The table compiles the diverse evidence for clothing derived from human and anthropomorphic depictions found across Eurasia. It lists the evidence, sorted for country and site, for every depiction of relevance in this context. To facilitate easy access to primary literature, figure and catalogue number references are given to some of the more comprehensive catalogues.

***Tab. 1 (auf den folgenden Seiten)*** *Paläolithische und mesolithische Kunst mit Darstellungen von Kleidung. Die Tabelle fasst die vielfältigen Hinweise auf Kleidung in menschlichen und anthropomorphen Darstellungen Eurasiens zusammen. Sie listet die Belege, sortiert nach Land und Fundstelle, für jede in diesem Zusammenhang relevante Darstellung auf. Um den Zugang zur Primärliteratur zu erleichtern, werden für einige der umfassenderen Belege Verweise auf Abbildungen und Katalognummern angegeben.*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| **Austria** | | | | | | | | | |
| Willendorf | | | | | | | | | |
| »Willendorf Venus« | 3D | sandstone | | human | WD | (3D) | ♀ | hairnet (or hairstyle?) | |
| **Czech Republic** | | | | | | | | | |
| Dolní Věstonice | | | | | | | | | |
| No. 12 (Verpoorte 2000, Fig. 3.24), Venus I | 3D | fired clay | | human | WD | (3D) | ♀ | 4 holes in the head (insertions?) | belt? |
| No. 15 (Verpoorte 2000, Fig. 3.29) | 3D | fired clay | | human | WD | (3D) | ? | 4 holes in the head (insertions?) | |
| No. 1 (Verpoorte 2000, Fig. 3.2), Venus V | 3D | ivory | | human | WD | (3D) | ♀? | | belt? |
| No. 6 (Verpoorte 2000, Fig. 3.9), Venus IX | 3D | fired clay | | human | WD | (3D) | ? | | belt? |
| No. 10 (Verpoorte 2000, Fig. 3.13) | 3D | fired clay | | anthropo-morph | WD | (3D) | ♀ | | belt? |
| Pavlov | | | | | | | | | |
| No. 21 (Verpoorte 2000, Fig. 3.54) | 3D | fired clay | | human | WD | (3D) | ? | | rope around the body below but-tocks |
| No. 22 (Verpoorte 2000, Fig. 3.55) | 3D | fired clay | | human | WD | (3D) | ? | | rope around the body |
| No. 23 (Verpoorte 2000, Fig. 3.56) | 3D | fired clay | | human | WD | (3D) | ? | | rope around the body |
| (Verpoorte 2000, Fig. 3.61) | 3D | fired clay | | human | WD | (3D) | ? | | rope around the ›neck‹? |
| **Denmark** | | | | | | | | | |
| Jordløse Mose | | | | | | | | | |
| | 2D | antler (perfora-ted) | | tall anthropo-morph, dia-mond-shaped head | Mesol. | right | (no) | | |
| Ryemarksgård | | | | | | | | | |
| | 2D | bone (metapo-dial, aurochs) | #1 | anthropo-morph, triangular head | Mesol. | front or back | (no) | | |
| | | | #2 | | Mesol. | right | (no) | | |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| armband | | MUP | Gravettian | 29–30 | Angeli 1989; Antl-Weiser 2008a; 2008b | 128 | LIX | | |
| | | MUP | Gravettian | 30–32 | Delporte 1993; Verpoorte 2000 | 131 | | | |
| | | MUP | Gravettian | 30–32 | Delporte 1993; Verpoorte 2000 | 133 | | | |
| | | MUP | Gravettian | 30–32 | Delporte 1993; Verpoorte 2000 | 134 | | | |
| | punched pattern | MUP | Gravettian | 30–32 | Delporte 1993; Verpoorte 2000 | 138 | | | |
| | | MUP | Gravettian | 30–32 | Delporte 1993; Verpoorte 2000 | 146 | | | |
| | | MUP | Gravettian | 31–33 | Delporte 1993; Verpoorte 2000 | 151b | | | |
| | | MUP | Gravettian | 31–33 | Delporte 1993; Verpoorte 2000 | 155b | | | |
| | | MUP | Gravettian | 31–33 | Verpoorte 2000 | | | | |
| | | MUP | Gravettian | 31–33 | Verpoorte 2000 | 155a | | | |
| | pattern of parallel oblique lines | Mesol. | Maglemo-sian? | 8.5–11.6 | Petersen 2024 | | | | |
| | fishbone pattern, oriented so that the figure's head looks like a fishtail | early Mesol. | Maglemosian | 8.5–11.6 | Sørensen 2023 | | | | |
| | torso: cross-hatched pattern | | | | | | | | |

*Continued on the next page*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| | 2D | bone (metapodial, aurochs) | #3 | anthropomorph, triangular head | Mesol. | right | (no) | | |
| | | | #4 | anthropomorph, rhombic head | Mesol. | right | (no) | | |
| | | | #5 | anthropomorph, triangular head | Mesol. | front or back | (no) | | |
| **Sindalgård** | | | | | | | | | |
| | 2D | amber (pendant) | #1 | tall anthropomorph, diamond-shaped head | Mesol. | front or back | (no) | | |
| | | | #2 | | Mesol. | front or back | (no) | | |
| | | | #3 | tall anthropomorph | Mesol. | front or back | (no) | | |
| | | | #4 | tall anthropomorph, diamond-shaped head? | Mesol. | front or back | (no) | | head or ›handbag‹-like accessory held in one hand |
| | | | #5 (floating on top of #1–4) | | Mesol. | front or back | (no) | | |
| **Veksø Mose** | | | | | | | | | |
| | 2D | antler (perforated) | left | tall anthropomorph, diamond-shaped head | Mesol. | front or back | (no) | | |
| | | | right | | Mesol. | front or back? | ♂? | | |
| **France** | | | | | | | | | |
| **Bédeilhac** | | | | | | | | | |
| MAN 75626 | 3D | tooth (incisor, horse) | | human | | (3D) | ? | hood? (or hairstyle?) | |
| MAN 776261 | 2D | sandstone | | human | | left | ♂? | | belt? |
| **Brassempouy** | | | | | | | | | |
| MAN 47019: »Dame à la Capuche« | 3D | ivory | | human | WD | (3D) | ♀? | hairnet (or hairstyle?) | |
| MAN 47260: »Manche de poihnard« | 3D | ivory | | human | WD | (3D) | ♀ | | flat object (?) on the back above the buttocks |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| | torso: cross-hatched pattern | early Mesol. | Maglemosian | 8.5–11.6 | Sørensen 2023 | | | | |
| | torso: cross-hatched pattern | | | | | | | | |
| | fishbone pattern, oriented so that the figure's head looks like a fishtail | | | | | | | | |
| | pattern of parallel oblique lines | Mesol. | Maglemosian? | 8.5–11.6 | Brinch Petersen/ Toft 2023 | | | | |
| | few oblique lines | | | | | | | | |
| | few oblique lines | | | | | | | | |
| | pattern of parallel oblique lines | | | | | | | | |
| | pattern of parallel oblique lines | | | | | | | | |
| | multiple short lines going inwards from the figure's outline | Mesol. | Maglemosian? | 8.5–11.6 | Sørensen 2023 | | | | |
| | cross-hatched pattern across head and body | | | | | | | | |
| | | LUP | mid-Magdalenian | 16–18 | Delporte 1993 | 27 | | | |
| | | LUP | | 16–18 | Duhard 1996 | | | 22 | |
| | | MUP | Gravettian | 24–26 | Delporte 1993; Duhard 1993 | 7 | VI, 3 | | |
| | | MUP | Gravettian | 24–26 | Delporte 1993; Duhard 1993 | 8 | VI, 2 | | |

*Continued on the next page*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| **Bruniquel** | | | | | | | | | |
| MAN MCIIF 312 82723 | 2D | bone (rib) | | human | | front | ♀? | | vertical line of 6 ›buttons‹ along the centre of the torso |
| **Cro-Magnon** | | | | | | | | | |
| MP A 6123 CM | 2D | bione | | anthropomorph | | right | ♀? | | |
| **Les Fadets** | | | | | | | | | |
| | 2D | limestone | | human | | right | ? | | belt? |
| **Gabillou (parietal)** | | | | | | | | | |
| »Femme à l'anorak« | 2D | limestone | | human | | left | ? | hood? (or hairstyle?) | |
| **Isturitz** | | | | | | | | | |
| MAN 84772 | 2D | bone (rib) | leading | human | | right | ♀ | | |
| | | | following | human | | right | ♀? | | |
| **Laugerie-Basse** | | | | | | | | | |
| MAN 47001 | 2D | bone (bovine) | | human | | left | ♀ | | |
| MAN 53919 | 2D | bone | | tall anthropomorph, diamond-shaped head | | left | ? | | |
| **Laussel** | | | | | | | | | |
| »Femme à la tête quadrillée« | bas-relief | stone | | human | WD | front | ♀ | hairnet (or hairstyle?) | |
| »Chasseur« | bas-relief | stone | | human | WD | right | ♀ | | belt? |
| **Lespugue** | | | | | | | | | |
| Musée de l'Homme, L.A.38189 | 3D | ivory | | human | WD | (3D) | ♀ | | shroud (?) (back) |
| **La Marche** | | | | | | | | | |
| observation no. 22 | 2D | limestone | | human | WD | right | ? | head band | |
| observation no. 29 | 2D | limestone | | human | WD | left | ♀ | cap? (or hairstyle?), head band? | shroud (?) (back) |
| observation no. 34 | 2D | limestone | | human | WD | left | ♂ | hood? (or hairstyle?) | |
| observation no. 36 | 2D | limestone | | human | WD | left | ♀ | | |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| | | LUP | mid-Magdalenian | 16–19 | Leroi Gourhan 1965; Delporte 1993; Duhard 1993; Duhard 1996 | 29 | L, 2 | 90b | |
| | torso filled with chevrons | MUP | Gravettian | 32–33 | Delporte 1993 | 57 | | | |
| | | LUP? | Magdalenian? | 16–18 | Delporte 1993; Duhard 1993; Duhard 1996 | 81 | XLIX, 1 | 19 | |
| | | LUP | mid-Magdalenian | 17–19 | Delporte 1993; Duhard 1996 | 68 | | 94 | |
| necklace and anklet | body ornamented by multiple short lines | LUP | Late Magdalenian | 14–16 | Delporte 1993; Duhard 1993 | 18 | XXXVI, 4 | | |
| necklace and armband | | | | | Delporte 1993; Duhard 1993; Duhard 1996 | | | 5 | |
| armband? and anklet? | belly ornamented by multiple short lines | LUP | Late Magdalenian | 14–16 | Delporte 1993; Duhard 1993; Duhard 1996 | 53a | XXXIV, 1 | 93 | |
| | multiple short lines going inwards from the figure's outline | LUP | mid-Magdalenian? | 14–17 | Duhard 1996 | | | 67 a+b | |
| | | MUP | Gravettian | 24–26 | Delporte 1993; Duhard 1993 | 44 | XVIII | | |
| | | MUP | Gravettian | 24–26 | Delporte 1993; Duhard 1993; Duhard 1996 | 47 | XXI | 21 | |
| | | MUP | Gravettian | 24–26 | Delporte 1993; Duhard 1993 | 19 | XIII | | |
| | | LUP | mid-Magdalenian | 17–18 | Pales/Tassin de Saint Péreuse 1976 | | LXI, 3 | 100,22 | |
| armband(s) | | | | | | | | 10,29" | |
| | | | | | | | | | |
| armband and anklet | | | | | | | | | |

*Continued on the next page*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| observation no. 37 | 2D | limestone | | human | WD | right | ♀ | | belt |
| observation no. 38 | 2D | limestone | | human | WD | right | ♀ | head band | |
| observation no. 40 | 2D | limestone | | human | WD | right | ? | cap | belt |
| observation no. 43 | 2D | limestone | | human | WD | right | ♂? | cap | belt |
| observation no. 47 | 2D | limestone | | human | WD | right | ♀ | | shroud (?) |
| observation no. 49 | 2D | limestone | | human | WD | left | ♀ | | broad belt (filled with cross-hatched pattern) |
| observation no. 54 | 2D | limestone | | human | WD | right | ♀ | | belt? |
| observation no. 60 | 2D | limestone | | human | WD | frontal-right | ♂ | | |
| Mas d'Azil | | | | | | | | | |
| MAN 48120 | 2D | bone (rondelle) | | tall anthropomorph, diamond-shaped head | | left | ♂ | | |
| **Germany** | | | | | | | | | |
| Andernach-Martinsberg | | | | | | | | | |
| large ivory statuette | 3D | ivory | | anthropomorph | GÖ | (3D) | ♀ | | |
| Geißenklösterle | | | | | | | | | |
| »Adorant« | 3D | ivory | | anthropomorph (therianthrope?) | | front | ? | | pelt-coat? |
| Gönnersdorf | | | | | | | | | |
| plaquette no. 6 | 2D | schist | | anthropomorph | GÖ | right | ♀ | | |
| plaquette no. 73 | 2D | schist | #73.2 | anthropomorph | GÖ | right | ♀ | | shoes? (or feet?) |
| plaquette no. 87 | 2D | schist | #87.1 | anthropomorph | GÖ | right | ♀ | | |
| | | | #87.2 | anthropomorph | GÖ | right | ♀ | | |
| | | | #87.3 | anthropomorph | GÖ | right | ♀ | | |
| | | | #87.4 | anthropomorph | GÖ | right | ? | | |
| | | | #87.5 | anthropomorph | GÖ | right | ♀ | | |
| Vogelherd | | | | | | | | | |
| | 3D | ivory | | anthropomorph (therianthrope?) | | (3D) | (no) | | pelt-coat? |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| armband | | LUP | mid-Magdalenian | 17–18 | Pales/Tassin de Saint Péreuse 1976 | | LXII, 1 | 86 | |
| | | | | | | | LXVI, 1 | | |
| armband | | | | | | | LXIII, 2 | 100,40' | |
| | | | | | | | | 100,43' | |
| anklet? | | | | | | | | | |
| armband? | | | | | | | | | |
| | | | | | | | | | |
| armband | | | | | | | | | |
| | multiple short lines going inwards from the figure's outline | LUP/LP | mid- to Final Magdalenian/ Azilian | 17–14 | Duhard 1996 | | | 70 | |
| | 2 pairs of engraved lines | LUP | Magdalenian | 15.8 | Veil 1982 | 115 | | | |
| | ›punch‹ pattern | EUP | Aurignacian | 38–40 | Hahn 1982; Floss 2007 | 120 | | | |
| | hatched pattern | LUP | Magdalenian | 15.8 | Bosinski et al. 2001 | | | | |
| | | LUP | Magdalenian | 15.8 | Bosinski et al. 2001 | | | | |
| | hatched and cross-hatched pattern | LUP | Magdalenian | 15.8 | Bosinski et al. 2001 | 113 | LXVIII, 1 | 97,1 | |
| | hatched and cross-hatched pattern | | | | | | LXVIII, 2 | 97,2 | |
| | hatched and cross-hatched pattern | | | | | | LXVIII, 3 | 97,3 | |
| | hatched pattern | | | | | | LXVIII, 4 | 97,4 | |
| | hatched pattern | | | | | | LXVIII, 5 | 97,5 | |
| | ›punch‹ pattern | EUP | Aurignacian | 35–40 | Riek 1934; Floss 2007 | 121 | | | |

*Continued on the next page*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| **Italy** | | | | | | | | | |
| Addaura (parietal) | | | | | | | | | |
| left wall | 2D | limestone | #23 | human | | left | ♀? | | carrying sack/ ›backpack‹ |
| | | | #24 | human | | right | ♂? | hood | belt |
| | | | #26 | human | | front or back? | ? | | belt |
| | | | #28 | human | | right | ♂? | hood | belt |
| | | | #29 | human | | right | ♂? | hood? | belt |
| | | | #31 | human | | front or back | ♂? | | belt |
| | | | #32 | human | | right | ♂? | hood | belt |
| | | | #33 | human | | right | ♂? | hood | belt |
| | | | #35 | human | | right | ? | | belt |
| | | | #36 | human | | left | ? | | belt? |
| Grimaldi | | | | | | | | | |
| »The Janus« | 3D | stone | | human | WD | (3D) | ♀ | hood | |
| »The Ochred Lady« | 3D | ivory | | human | WD | (3D) | ♀ | hood? (or hairstyle?) | |
| »The Bust« | 3D | stone | | human | WD | (3D) | ? | hood | |
| »The Negroid Head« | 3D | stone | | human | WD | (3D) | ♀? | hair net (or hairstyle?) | |
| **Netherlands** | | | | | | | | | |
| Geldrop | | | | | | | | | |
| »The Dancer« | 2D | stone (pebble) | | human | | front | ♀ | | loincloth |
| Wanssum | | | | | | | | | |
| | 2D | stone (pebble) | | human | | front | ♂? | | loincloth |
| Valkenburg-Straatbeek | | | | | | | | | |
| | 2D | stone (pebble) | | anthropo-morph, triangular head | Mesol. | front or back | (no) | | |
| **Russia** | | | | | | | | | |
| Avdeevo | | | | | | | | | |
| Cat. 36,36 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | cap? (or hairstyle?) | breastband |
| Cat. 36,37 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | |
| Cat. 36,38 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 99 | |
| | | | | | | 101 | | | |
| | | | | | | | | | |
| | | | | | | 101 | | | |
| | | LP | Epi-Gravettian | 14 | Di Maida et al. 2020 | 101 | | | |
| | | | | | | 101 | | | |
| | | | | | | 101 | | | |
| | | | | | | 101 | | | |
| | | | | | | 101 | | | |
| | | | | | | 101 | | | |
| | | MUP | Gravettian | 23–28 | Mussi et al. 2000 | 90 | XII | | |
| | | MUP | Gravettian | 23–28 | Mussi et al. 2000 | | | | |
| | | MUP | Gravettian | 23–28 | Mussi et al. 2000 | | | | |
| | | MUP | Gravettian | 23–28 | Mussi et al. 2000 | 95 | | | |
| | | LP? | Ahrens-burgian? | 11–13 | Verhart/d'Errico 2012 | 110 | | | |
| | | (no)<br>LP to Mesol.? | no | 11–14 | Verhart/d'Errico 2012 | | | | |
| | cross-hatched pattern across body and head | (no)<br>Mesol.? | Mesol. | 8.5–11.6 | Amkreutz/ Niekus 2023 | | | | |
| armbands? | | MUP | Gravettian | 23–25 | Delporte 1993; Abramova 1995 | 183 | | | 43,3 |
| armband | | MUP | Gravettian | 23–25 | | 184 | | | 43,2 |
| armband | | MUP | Gravettian | 23–25 | | 185 | | | 43,1 |

*Continued on the next page*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| **Buret'** | | | | | | | | | |
| Cat. 90,1 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | hood | |
| Cat. 90,2 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | hood? (or hairstyle?) | |
| Cat. 90,3 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | hood? (or hairstyle?) | |
| **Gagarino** | | | | | | | | | |
| Cat. 38,2 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | cap (or hairstyle?) | |
| **Kostenki I** | | | | | | | | | |
| Cat. 42,1 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | breastband (also on back side), belt? |
| Cat. 42,2 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | belt |
| Cat. 42,3 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | belt |
| Cat. 42,53 (Abramova 1995) | 2D | marlstone | | human | WD | front | ♀ | | breastband |
| **Kostenki I, 2** | | | | | | | | | |
| Cat. 42,163 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | breastband |
| Cat. 42,164 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood? | |
| Cat. 42,165 (Abramova 1995) | 3D | marlstone | | human | WD | (3D) | ♀ | | ›bra‹-like breastband |
| Cat. 42,166 (Abramova 1995) | 3D | marlstone | | human | WD | (3D) | ♀? | hairnet (or hairstyle?) | |
| Cat. 42,172 (Abramova 1995) | 3D | marlstone | | human | WD | (3D) | ♀ | | ›manacles‹ |
| **Mal'ta** | | | | | | | | | |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| | ›punch‹ pattern | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 211,1 | | | 115,5 |
| | | MUP | Gravettian | 23–24 | | 211,2 | | | 115,1 |
| | | MUP | Gravettian | 23–24 | | 211,3 | | | 115,3 |
| | | MUP | Gravettian | 25 | Delporte 1993; Abramova 1995 | 190 | | | 52,2 |
| | | MUP | Gravettian | 23–26 | Delporte 1993; Abramova 1995 | 166 | | | 59,1 |
| necklace | | MUP | Gravettian | 23–26 | | 167 | | | 59,2 |
| | | MUP | Gravettian | 23–26 | | 168 | | | 60,1 |
| | | MUP | Gravettian | 23–26 | | 164 | | | 62,10 |
| | | MUP | Gravettian | 23–26 | Delporte 1993; Abramova 1995 | 169 | | | 73,2 |
| | | MUP | Gravettian | 23–26 | | 173 | | | 73,1 |
| wristbands and armlets | | MUP | Gravettian | 23–26 | | 174 | | | 74,4 |
| | | MUP | Gravettian | 23–26 | | 176 | | | 74,7 |
| | | MUP | Gravettian | 23–26 | | 175 | | | 76 |

*Continued on the next page*

| Object | Technique: sculpture (3D); engraving (2D) | Material | Figure no. within a scene | Type of depiction | Style/type: Willendorf (WD); Gönnersdorf (GÖ); Mesolithic (Mesol.) | Viewed from … | Sex | Headcover | Clothing item(s) |
|---|---|---|---|---|---|---|---|---|---|
| Cat. 89,1 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood? | |
| Cat. 89,3 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | | |
| Cat. 89,4 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | hood? (or hairstyle?) | |
| Cat. 89,5 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood | |
| Cat. 89,6 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood | |
| Cat. 89,7 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood? (or hairstyle?) | |
| Cat. 89,8 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | |
| Cat. 89,9 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood? | |
| Cat. 89,10 (Abramova 1995) | 3D | antler (reindeer) | | human | WD | (3D) | ? | hood? (or hairstyle?) | |
| Cat. 89,11 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | hood? (or hairstyle?) | |
| Cat. 89,13 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀? | hood? | |
| Cat. 89,16 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | | |
| Cat. 89,17 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | hood? (or hairstyle?) | |
| Cat. 89,18 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | | |
| Cat. 89,19 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | | |
| Cat. 89,23 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood? (or hairstyle?), ponytail? (or ornamentation?) | |
| Cat. 89,24 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ♀ | hood? (or hairstyle?) | |
| Cat. 89,27 (Abramova 1995) | 3D | ivory | | human | WD | (3D) | ? | | |
| **Ukraine** | | | | | | | | | |
| Mezhyrich | | | | | | | | | |
| Cat. 21,1 (Abramova 1995) | 3D | bone (mammoth) | | anthropomorph | | (3D) | ♀ | | |
| Mezin | | | | | | | | | |
| Cat. 23,1 (Abramova 1995) | 3D | ivory | | anthropomorph | | (3D) | ♀ | | |
| Cat. 23,2 (Abramova 1995) | 3D | ivory | | anthropomorph | | (3D) | ♀ | | |
| Cat. 23,3 (Abramova 1995) | 3D | ivory | | anthropomorph | | (3D) | ♀ | | |

| Personal ornaments | Decoration | Archaeol. Period<br>Early Upper Pal. (EUP)<br>mid-Upper Pal. (MUP)<br>Late Upper Pal. (LUP)<br>Late Pal. (LP)<br>Mesolithic (Mesol.) | Archaeological »culture« | Age (~ka cal BP) | Reference | Fig. no. in Delporte 1993 | Fig. no. in Duhard 1993 | Fig. no. in Duhard 1996 | Fig. no. in Abramova 1995 |
|---|---|---|---|---|---|---|---|---|---|
| | | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209,1 | | | 102,1 |
| | ›punch‹ pattern | MUP | Gravettian | 23–24 | | 209,3 | | | 102,3 |
| | | MUP | Gravettian | 23–24 | | 209,4 | | | 103,1 |
| | | MUP | Gravettian | 23–24 | | 209,5 | | | 102,4 |
| | | MUP | Gravettian | 23–24 | | 209,6 | | | 102,6 |
| | | MUP | Gravettian | 23–24 | | 209,7 | | | 103,2 |
| | | MUP | Gravettian | 23–24 | | 209,8 | | | 103,4 |
| | ornamentation of buttocks (lower end of ›parka‹?) | MUP | Gravettian | 23–24 | | 209,9 | | | 102,7 |
| | | MUP | Gravettian | 23–24 | | 209,10 | | | 103,3 |
| | | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209,11 | | | 104,2 |
| | ›wrapping‹ pattern | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209,13 | | | 102,2 |
| | ›wrapping‹ pattern | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209, 16 | | | 105,1 |
| | | MUP | Gravettian | 23–24 | Abramova 1995 | | | | 105,7 |
| | | MUP | Gravettian | 23–24 | Abramova 1995 | | | | 105,6 |
| | | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209, 19 | | | 104,6 |
| armlet? | ornamentation of right chest by rope or leafed twig (?), or ponytail? | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209, 23 | | | 104,3 |
| | | MUP | Gravettian | 23–24 | Delporte 1993; Abramova 1995 | 209, 24 | | | 105,5 |
| | ›wrapping‹ pattern | MUP | Gravettian | 23–24 | Abramova 1995 | | | | 105,2 |
| | frontal torso: groups of horizontal lines | LUP | Epi-Gravettian | 17.5–18.5 | Abramova 1995; Delporte 1993; Jöris 2021 | 207b | | | 11,2 |
| | patterns of chevrons, ›angular meanders‹, sets of parallel lines | LUP | Epi-Gravettian | 16.5–17.5 | Abramova 1995; Jöris 2021 | | | | 14,1 |
| | patterns of chevrons, ›angular meanders‹, sets of parallel lines | LUP | Epi-Gravettian | 16.5–17.5 | Abramova 1995; Jöris 2021 | | | | 14,4 |
| | patterns of chevrons, ›angular meanders‹ | LUP | Epi-Gravettian | 16.5–17.5 | Abramova 1995 | | | | 14,3 |

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## Source of figures

1 redrawn and modified from Cluzel/Cleyet-Merle 2011; Leroi-Gourhan 1971
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3 photos, orthophoto and modelling G. Di Maida; modified from Mussi et al. 2023; numbers according to Di Maida et al. 2020
4 a Verhart/d'Errico 2012; cf. Amkreutz/Niekus 2023; drawing from Verhart 2015, courtesy L. Verhart; photograph National Museum of Antiquities Leiden; b Verhart/d'Errico 2012; cf. Niekus/Amkreutz 2021
5 Jöris 2021; redrawn and modified by G. Rutkowski and N. Viehöver from Chovkoplass 1965
6 Jöris 2021; redrawn and modified by G. Rutkowski and N. Viehöver from Chovkoplass 1965
7 Volker Iserhardt, LEIZA; after Jöris 2021; Gaudzinski-Windheuser/Jöris 2015; cf. Bosinski et al. 2001: plaquette no. 87, the so called »Strickvenüsse«
8 a Amkreutz/Niekus 2023; drawing from Verhart 2015, courtesy L. Verhart; photograph National Museum of Antiquities Leiden; b Sørensen 2023; CC BY-SA, Roberto Fortuna & Kira Ursem, The National Museum of Denmark
9 a Brinch Petersen/Toft 2023; pendant inv. nr. A48088 from Sindalgård, Åmosen, CC BY-SA, Roberto Fortuna & Kira Ursem, The National Museum of Denmark; b Sørensen 2023; CC BY-SA, Roberto Fortuna & Kira Ursem, The National Museum of Denmark
10 O. Jöris of a cast, stored in the MONREPOS Archaeological Research Centre and Museum of Human Behavioural Evolution, arranged and modified by N. Viehöver; reference: Abramova 1995, Cat. 42,172
11 O. Jöris of a cast, stored in the MONREPOS Archaeological Research Centre and Museum of Human Behavioural Evolution, arranged and modified by N. Viehöver; reference: Abramova 1995, Cat. 42,165
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13 after Brunn 2007; Wolf 2008
14 redrawn and modified from Delporte 1993; Pales/Tassin de Saint Péreuse 1976

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# Appearance and perceptions of Neolithic figurines – Nuances of covering and nudity: Evidence from Greece

Christina Marangou

**Zusammenfassung**

Wirkung und Wahrnehmung neolithischer Figurinen – Aspekte von Verhüllung und Nacktheit: Beispiele aus Griechenland

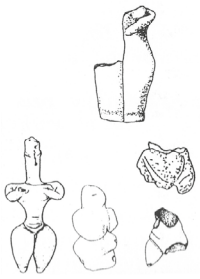
*Neolithische* Eidolia *(dreidimensionale kleine Darstellungen) können Wesen, Artefakte und Themen widerspiegeln, die entweder auf konkrete Dinge Bezug nehmen und im wirklichen Leben existieren oder von ihren Schöpfern erdacht wurden. Die Identifizierung spezifischer ikonographischer Merkmale und die Rückschlüsse auf die Gründe für ihre Auswahl bleiben jedoch eine Herausforderung. Insbesondere auf anthropomorphen Tonfiguren können Kleidung oder Bedeckungen des Körpers, des Kopfes und der Gliedmaßen dargestellt, hervorgehoben oder angedeutet werden; auch »Nacktheit« kommt vor, was auf unterschiedliche Bedeutungen und Aspektnuancen schließen lässt. Das Erscheinungsbild der Figuren kann Bedeutungen impliziert, ausgedrückt oder verschlüsselt haben, die über regionale und zeitliche Trends und typologische Variationen hinausgehen und sich hinter einer Vielzahl von Fassaden verbergen. Ziel dieser Studie ist es, die potenziellen Interpretationen und Funktionen spezifischer Merkmale auf den Figurinen zu erkennen, die möglicherweise mit Kleidung, Gewändern oder allgemein mit »Bedeckung« zu tun haben. Eine Reihe dieser Bilder, die in häuslichen Kontexten in Griechenland gefunden wurden und potenziell signifikante ikonographische Elemente aufweisen, wird hier untersucht, um mögliche Hypothesen zur Identifizierung solcher dargestellten Elemente vorzuschlagen und zu überprüfen. Darüber hinaus wird versucht, spezifische ikonographische Merkmale und ihre Position auf den Figurinen mit Artefaktbelegen aus häuslichen und Grabkontexten zu vergleichen. Die vorgestellten Figurinen datieren aus dem Frühen Neolithikum bis zum Endneolithikum und stammen hauptsächlich aus Mazedonien, Thrakien und Thessalien – Parallelen und Nachweise aus verwandten, vergleichbaren neolithischen Kulturen in anderen Regionen Südosteuropas und dem Nahen Osten werden ebenfalls berücksichtigt. Die möglichen Wahrnehmungen und »Lesarten« der dargestellten Menschen werden erörtert, wobei der Schwerpunkt auf ihrem Aussehen liegt, ob sie nun bedeckt, nackt oder etwas dazwischen sind.*

**Schlagwörter** Anthropomorphe Figurinen, Neolithikum, Griechenland, Bedeckung, Nacktheit

**Summary**

*Neolithic* eidolia *(three-dimensional small images) may reflect beings, artefacts, and themes, either concrete and existing in real life or imagined by their human creators. Identifying specific iconographic features and inferring reasons for their selection remains challenging. On anthropomorphic clay figurines, in particular, clothing or coverings of the body, head, and limbs may be represented, emphasised, or inferred; ›nudity‹ also occurs, suggesting varied meanings and nuances. The figurines' appearance may have implied, expressed or encoded meanings deeper than regional and temporal trends and typological variations, hidden behind a variety of façades. This study aims to recognise the potential interpretations and functions of specific features present on the figurines, possibly related to clothing, garments or ›covering‹ in general. A number of these images, found in domestic contexts in Greece and bearing potentially significant iconographic features, are examined here in order to propose and verify possible hypotheses for the identification of such represented elements. Additionally, an attempt is made to compare specific iconographic features and their position on figurines to artefactual evidence from domestic and burial contexts. The figurines presented date from the Early to the Final Neolithic period and originate mainly from Macedonia, Thrace and Thessaly – parallels and supporting evidence from related, comparable Neolithic cultures in other regions of Southeast Europe and the Near East are also taken into account. The potential perceptions and ›readings‹ of the humans represented are discussed, focussing on their appearance, whether covered, nude, or something in between.*

**Keywords** Anthropomorphic figurines, Neolithic, Greece, covering, nudity

| CHARACTERISTIC TYPES OF ANTHROPOMORPHIC FIGURINES OF MACEDONIA AND THRACE | | | | |
|---|---|---|---|---|
| Northern Greece (based on Andreou et al. 1996, 538 Tab. 1): | WESTERN MACEDONIA | CENTRAL MACEDONIA | EASTERN MACEDONIA | THRACE |
| FINAL NEOLITHIC (FN; Chalcolithic) 4700/4500–3300/3100 | | | | |
| LATE NEOLITHIC (LN) 5400/5300–4700/4500 | | | | |
| MIDDLE NEOLITHIC (MN) 5800/5600–5400/5300 | | | | |
| INITIAL/EARLY NEOLITHIC (EN) 6700/6500–5800/5600 |  | | | |

**Tab. 1** Characteristic types of anthropomorphic figurines from Macedonia and Thrace, Early to Final Neolithic.

***Tab. 1*** *Charakteristische Typenvarianz anthropomorpher Figuren aus Makedonien und Thrakien, Früh- bis Endneolithikum.*

## Introduction

In Neolithic Greece[1], anthropomorphic three-dimensional clay imagery is most often fragmentary, mostly female, and rarely male; it may also lack sex indication (more often in later phases; cf. Marangou 2009). Beyond decorative patterns, the details may reflect a concrete or imagined presence or even the absence of specific elements. These may constitute attributes of clothing, garments or accessories worn on the head, limbs, or body of depicted anthropomorphs, which may or may not represent real persons. Some of the attributes may be perceived as representing or implying actual items of clothing or indicating an enhancement with coverings in an (unknown) material. Ornaments, emphasised corporeal natural characteristics, marks, pigments or tattoos seem to be important on ›naked‹ (parts of) figurines and could show different ›levels‹ of nudity or even its accentuation. One should keep in mind that, originally, elements in perishable materials may also have been attached to the figurines, so the terms ›nude‹ or ›covered‹ could have had varied nuances and meanings.

Identification and interpretation, as well as any inferences about the reasons why certain details were selected to be represented, remain challenging; this is particularly the case when a figurine lacks a precise archaeological context. However, considering selected examples of figurines that present such details (beyond regional or chronological variations, naturalism or abstraction), potential perceptions and readings of Neolithic embodied humans and their appearance may be suggested. Here, the focus is on Early to Final Neolithic Greek[2] material from domestic (not burial) contexts, but also includes artefacts without contextual information, mainly from Northern Greece, Macedonia and Thrace (Tab. 1), as well as Thessaly. In addition, some parallels are mentioned from related, comparable Neolithic cultures in neighbouring regions, in South-Eastern Europe and the Near East (cf. Papathanasopoulos 1996, 24–25 Fig. 2). When available, reference is also made to actual garments or accessories found in domestic contexts – possibly depicted on figurines – while also taking into account existing evidence of such artefacts' connection to human burials. The present paper aims to propose possible directions or

1 General chronological framework of Neolithic archaeological phases for **Thessaly** (based on Reingruber et al. 2017, 50 Tab. 5):
**Initial Neolithic and Early Neolithic (EN):** 6600–5980 or: 7000 (including pre-ceramic)–5900 BC for Thessaly and the Balkans, according to Bonga 2019, 160 Fig. 2,
**Middle Neolithic (MN):** 5980–5500,
**Late Neolithic (LN):** 5500–4500,
**Final Neolithic (FN):** 4500–3300.
For a global general chronological table of the Neolithic in the Eastern Mediterranean and Haimos Peninsula (Χερσόνησος τοῦ Αἵμου) see Papathanasopoulos 1996, 28–29 Fig. 3.

2 Principal sites of the Neolithic in Greece: Papathanasopoulos 1996, 198–208 Fig. 60. Diagram of the development of Neolithic figurines, based on the pieces of the exhibition: Papathanasopoulos 1996, 144–145 Fig. 41.

supporting hypotheses for the identification and interpretation of such ›covering‹ elements represented on figurines.

## Figurine details implying actual human clothing or coverings

Actual personal ornaments may have been attached to figurines, e.g. rings or labrets made from organic or inorganic materials, including metal. These are either physically preserved or inferred from perforations in the clay or bone figurines' ears or mouths (Marangou 1993, 327; Marangou 1996, Fig. 7; Marangou 2020, 36–37 Fig. 2a–c) and are confirmed by burial evidence[3]. In addition, iconographic elements on figurines may represent garments (such as ›hoods‹) or embellishments that also served as functional fittings, hung, fastened, fixed, or sewn onto clothing or accessories. This may be implied by characteristics of real artefacts (e.g. multiple perforations on the periphery of a ring) originating from domestic contexts but may also be corroborated by funerary data indicating such items' connection to the garments or adornments of the dead. Some iconographic features could, therefore, imply the existence of such coverings on real humans. The depicted, incised, impressed, modelled or painted ornaments include single or multiple elements: necklaces, collars, rings around arms, wrists or ankles, belts, bands or straps with ›appliqués‹, buckles, ›diadems‹, headdresses, and hairnets (Marangou 1992a, 175–177; Marangou 1993; Marangou 2020).

## Covering bodies and limbs

Neolithic necklaces can be composed of multiple rows of varying numbers of beads, made of such materials as dentalium, stone, bone or animal teeth; necklaces vary in length, too, some amounting to hundreds of beads (Chondroyianni-Metoki 2022, 334). When an incised ›necklace‹ is draped over the incised hair/hairnet of a figurine (Fig. 1a–b; Marangou 2020, 52 Fig. 6), it may represent an embellishment strung on a cord. Conversely, when the ›necklace‹ stops at the shoulders in front (cf. Fig. 1c–d) and hair/›hairnet‹ is incised on the neck and upper shoulders, covering them (Marangou 1993, 328 Fig. 2a; Marangou 2019, Pl. 78, M220), it may not be a necklace. Instead, it could represent ornaments sewn or fastened onto a garment or patterns woven into clothing covering the torso, possibly indicated by additional decorative patterns on the body (cf. Fig. 1e–f). Arc- or V-shaped, long ›necklaces‹ may be composed of one or more rows and may reach down to the waist, just above the figurine's navel; a lower row may also form a loop between the figurine's breasts (cf. Fig. 1c) and is sometimes doubled or tripled on the back of the image, again reaching the waist. So-called ›counterweight necklaces‹[4] depicted on figurines display double or multiple arcs on the chest (cf. Fig. 1c.e); one row falls between the shoulder blades on the back, forming a V or a loop (cf. Fig. 1d.f; Fig 2a; Marangou

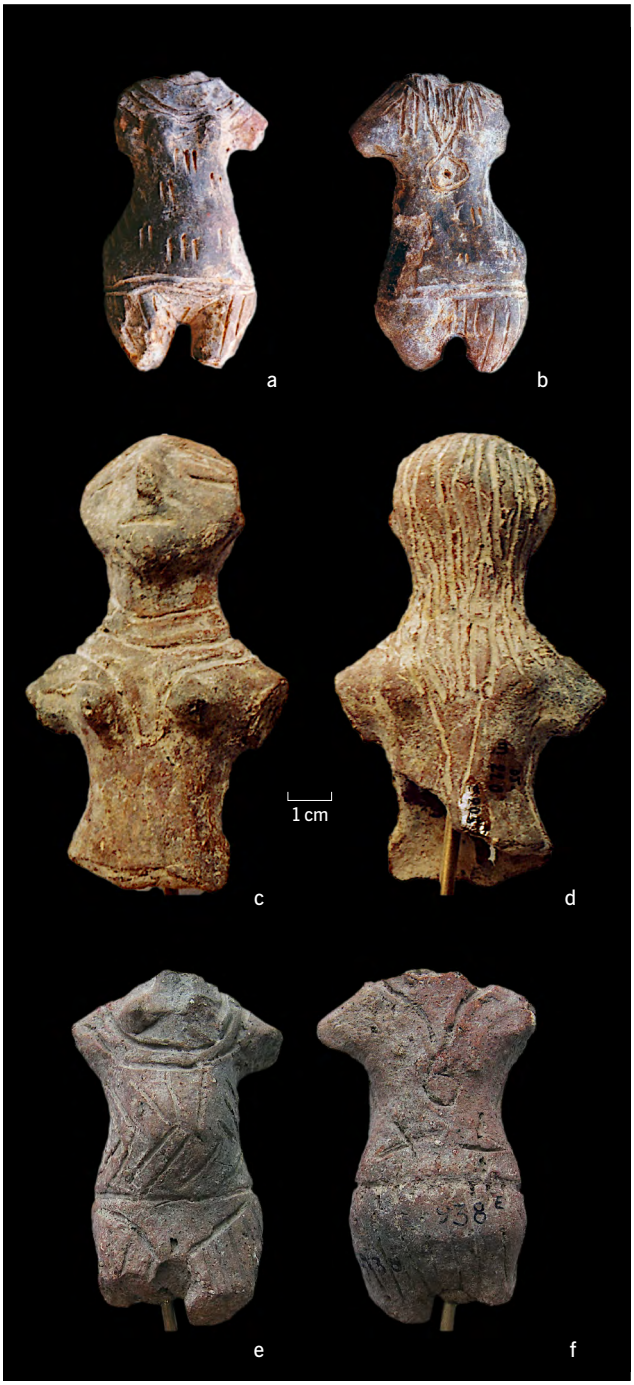



**Fig. 1a–f** Late Neolithic fragmentary female figurines with rich incised decoration, showing belts, ›necklaces‹, buckles and ›pendants‹ (Dikili Tash, Eastern Macedonia; e–f: Museum collection).

***Abb. 1a–f*** *Spätneolithische, fragmentarisch erhaltene Frauenfiguren mit reicher eingeritzter Verzierung, die Gürtel, Halsketten, Schnallen und Anhänger zeigen (Dikili Tash, Ost Mazedonien; e–f: Museumssammlung).*

3 E.g. in FN Varna, Bulgaria: Fol/Lichardus 1988, Fig. 36, labrets, earrings, and diadem on clay ›mask‹ in tomb 2; Le Premier Or 1989, 151; ›clous‹ on teeth of skeleton in tomb 134.

4 The term was an interpretation given to necklaces of later periods, supposedly comprising a heavy necklace on the front and a ›counterweight‹ on the back, in order to distribute the weight (Marangou 1993, 329 with references).

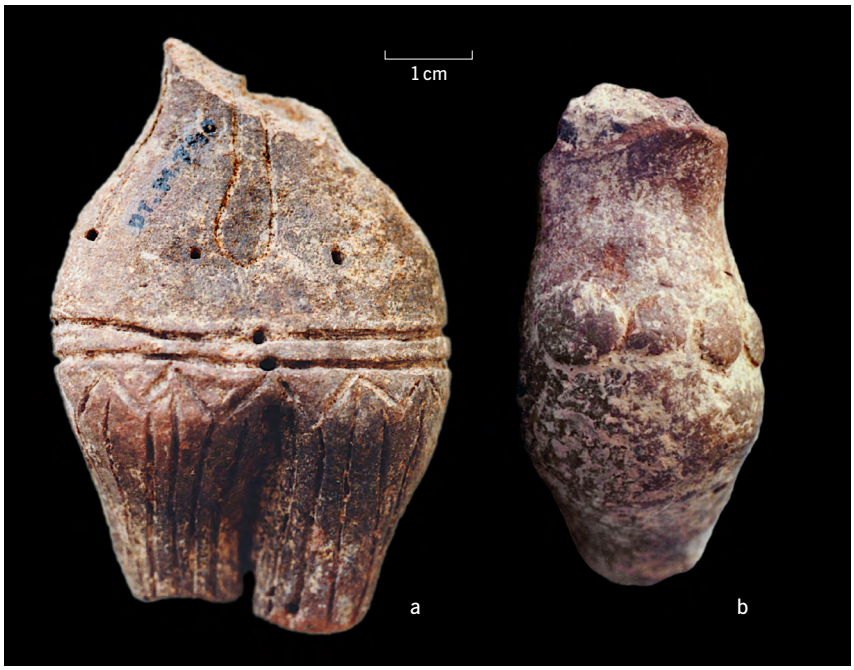
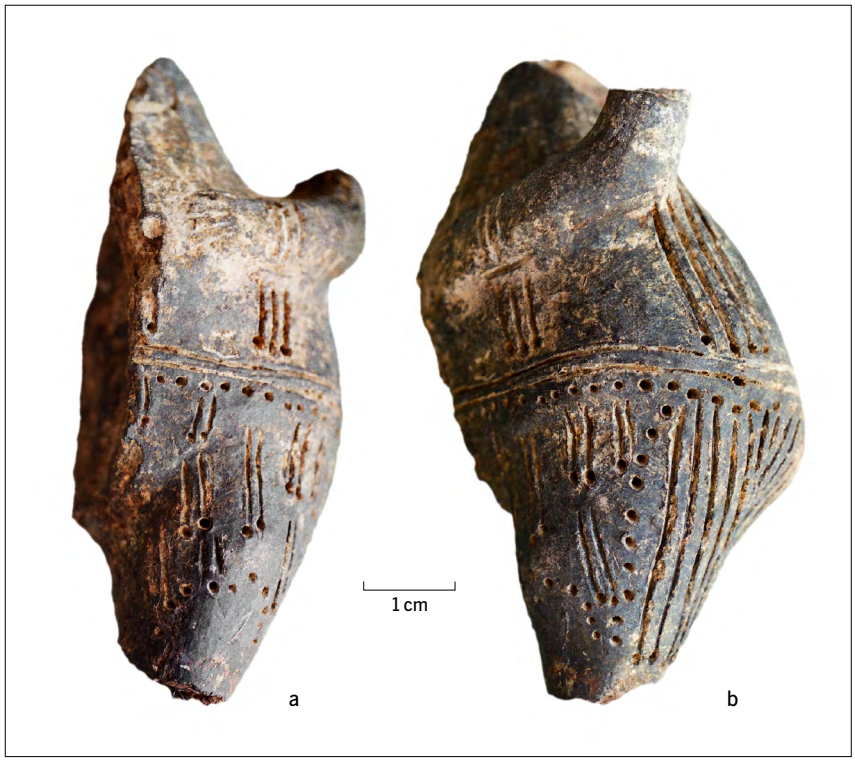



**Fig. 2a–b** a Late Neolithic fragmentary female figurine (lower body preserved) with rich incised decoration, belt, the loop of a necklace or garment on its lower back and legs wraps (Dikili Tash, Eastern Macedonia); b Late Neolithic fragmentary female figurine with modelled clay pellets around the hips (Thermi, Central Macedonia).

***Abb. 2a–b*** *a Spätneolithische, fragmentarisch erhaltene weibliche Figurine mit reicher eingeritzter Verzierung, Gürtel, »Halskette mit Gegengewicht« und Beinwickeln (Dikili Tash, Ostmakedonien); b spätneolithische, fragmentarisch erhaltene weibliche Figurine mit modellierten Tonkugeln um die Hüften (Thermi, Zentralmakedonien).*

**Fig. 3a–b** Late Neolithic richly decorated female body with belt, bracelets, knee decoration and multiple incised and dotted ornaments along body and legs, clothing embellishments or hanging decorations (Dikili Tash, Eastern Macedonia).

***Abb. 3a–b*** *Spätneolithischer, reich verzierter weiblicher Körper mit Gürtel, Armbändern, Kniedekorationen und zahlreichen Verzierungen entlang des Körpers und der Beine (Dikili Tash, Ostmakedonien).*




1993, 330 Fig 3a.d; 330 Fig. 4a; 331 Pl. I.2; Marangou 2020, 53 Fig. 7). A trapezoid ›pendant‹ may be shown (cf. Fig. 1f; Marangou 1993, 330 Fig 4a; 331 Pl. I,1; Marangou 2020, 52 Fig. 6), sometimes bearing a central impressed point (cf. Fig. 1b). This could have been a ring-shaped fitting (made of shell?) with a pin, that secured items of clothing on the back (or front) of a figurine. This would confirm the above-mentioned possibility that, at least in case the ›necklace‹ – ›counterweight‹ or not- is covered by hair/hairnet, instead of a necklace, it would rather depict clothing or garment details.

Multiple ›rings‹/bracelets are occasionally shown on figurines (Fig. 3; they may encircle both arms, the upper arms and/or the forearms or wrists, and possibly represent bracelets. Interestingly, burial evidence supports this interpretation: skeletons may wear one or more real bracelets on one or both arms, near the armpit or elbow (references in Marangou 1993, 327). ›Ankle rings‹ on figurines are less common (absent on foot in Fig. 4a) and more likely attested on the feet of anthropomorphic vessels. They may be indicated by either parallel horizontal incisions, occasionally filled with coloured paste, by grooves and impressed points (Fig. 4b) or modelled clay pellets (Grammenos/Kotsos 2002, 228). Parallel ›anklet‹ incisions may also appear on figurines, even if footwear is not explicitly shown; ›anklets‹ may even appear in the absence of modelled feet (Fig. 5;

**Fig. 4** Late Neolithic fragmentary figurines' or anthropomorphic vessels' feet (Dikili Tash, Eastern Macedonia). a Without decorative elements; b with incised and dotted motifs.

***Abb. 4*** *Spätneolithische, fragmentarisch erhaltene Figurinenfüße (Dikili Tash, Ostmakedonien). a Mit eingeritzten; b mit gepunkteten Motiven.*

Marangou 2020, 38–39). Actual ›rings‹ are made of shell, bone, stone, or clay, but may also have consisted of strings of beads or perforated shells. Ring-like depictions on figurines may then alternatively, instead of bracelets, represent such strings, attached to sleeves (as in Fig. 3), or the hems of leg wraps or ›trousers‹ (on ›trousers‹: cf. Sarri 2018, 168). Leg ›wraps‹ may in fact be suggested by parallel vertical lines incised along the legs (cf. Fig. 1a–b.e–f; Fig. 2a; Fig. 3).

Linear items encircling the hips of Late Neolithic (LN) female figurines would represent belts, both as functional fittings and clothing embellishments. They consist of simple or double incisions (cf. Fig. 1a–b.e–f), sometimes impressed with deep points and/or triangles or trapezoids incised parallel to the incised ›belts‹ (cf. Fig. 2a; Fig. 3; Gimbutas 1986, 231 Fig. 9; 10; 233 Fig. 14; 236 Fig. 21 Pl. LII,1a–b; Marangou 2020, 53–54 Fig. 7–8). Such impressed or incised patterns (cf. Fig. 2a) or modelled clay pellets (cf. Fig. 2b) may represent a series of beads or appliqués sewn on a garment, such as a hip band (Marangou 1992b, 25 Fig. 3,1–2; Adam-Veleni et al. 2017, 190 No. 21), and the ›hairnet‹ representations seem to comprise similar impressed dots (see further).

Belts are incised or modelled as a band, worn more often around the waist than the hips of rare LN male figurines (Fig. 5; Marangou 1992a, 421 Fig. 72d; Marangou 2019, Pl. 80, M491; Marangou 2020, 36 Fig. 9); this possibly implies a loin-cloth. In addition to a waist-belt or waist-band, male figurines may be depicted wearing a chest or shoulder strap diagonally across the thorax (LN–FN; several examples

**Fig. 5** Late Neolithic fragmentary male figurine with doubly incised waist belt, double U-shaped arch under right armpit and ›ring‹/anklet around preserved left leg extremity without foot indication (Dimitra, Eastern Macedonia).

***Abb. 5*** *Spätneolithische, fragmentarisch erhaltene männliche Figur mit eingeschnittenem Taillengürtel, doppeltem U-förmigem Bogen unter der rechten Achselhöhle und »Ring«/Fußkettchen um das erhaltene linke Ende eines Beines ohne Fußandeutung (Dimitra, Ostmakedonien).*

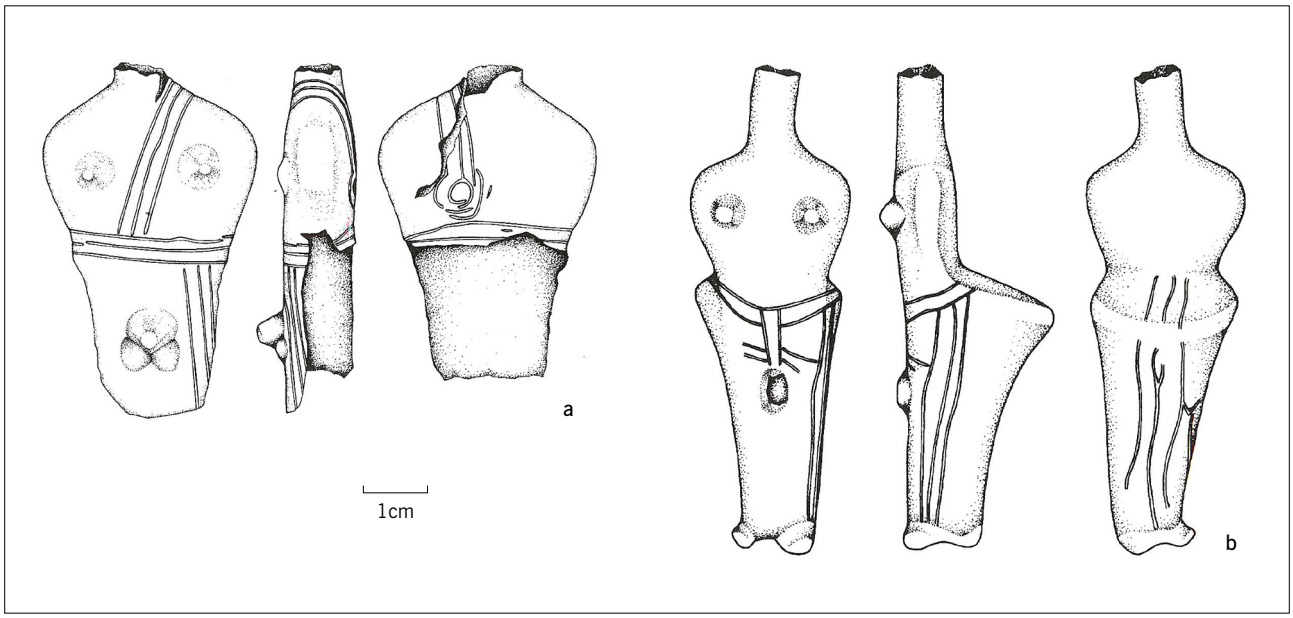



**Fig. 6a–b** Late Neolithic figurines from Makri: a Hermaphrodite or male with waist belt, diagonal strap on front and back of torso and hanging band on its right lower body; b Hermaphrodite or female with hip belt, a hanging band on the front, in the middle of the lower body and clothing folds or decoration on the side and back.

***Abb. 6a–b*** *Spätneolithische Figurinen aus Makri: a Hermaphrodit oder Männerfigur mit Hüftgürtel, diagonalem Riemen auf der Vorder- und Rückseite des Rumpfes und Hängegurt am rechten Unterkörper; b Hermaphrodit oder Frauenfigur mit Hüftgürtel, einem Hängegurt an der Frontseite, in der Mitte des Unterkörpers sowie Kleiderfalten oder Verzierungen an der Seite und am Rücken.*

from the Cucuteni-Trypillia Culture in Monah 2016, e.g. 192–193 Fig. 37–38; 195–196 Fig. 40–41; see also Marangou 2020, 36 with references). This has also been preserved on fragmentary examples as a double U-shaped arch incised below the armpit (cf. Fig. 5 on its right; Gimbutas 1982, 51 Fig. 10; Marangou 1997, Pl. 67c; Marangou 2020, Fig. 9). A figurine, interpreted as a hermaphrodite (LN Makri, Thrace, Greece, Efstratiou/Kallintzi 1994, 46 Fig. 31), displays a diagonal strap and a band-shaped waist-belt with an additional vertical band on the side, suspended over the figurine's hip (Fig. 6a; cf. Monah 2016, 193 Fig. 38.2). However, one should not exclude the possibility that the figurine represents a male, with the gender-typical waist-band and diagonal chest strap, since breasts are only slightly indicated (on the drawing). Another LN figurine from the same site, different than the previous one, similarly interpreted as a hermaphrodite (cf. Fig. 6b; Efstratiou/Kallintzi 1994, 46 Fig. 32; Adam-Veleni et al. 2017, 217 No. 95), could, in fact, represent a female, due to the characteristic body shape, accentuated breasts, the incised belt hanging below the belly, as normally female figurines' belts, with a central vertical band falling on the front and more parallel vertical and horizontal incisions encrusted with white material on the side and the back of the body and limbs; if so, the much lower modelled front detail could be part of the central, vertically incised hanging garment, instead of indicating male gender.

Actual accessories or applications found in domestic contexts may have been sewn on clothing or used to attach a garment or band, such as a buckle fixed on a belt band (Kyparissi-Apostolika 1992, Pl. 32a). Various types of artefacts may have served as buckles, including long, narrow clay buckles displaying four to five perforations (Ifantidis 2019, 163–168 Fig. 56). Other artefacts, with four perforations, interpreted as ›pendants‹, could instead be belt buckles (Chondroyianni-Metoki 2022, 341 Fig. 17). Additionally, some ring-shaped artefacts are too small (diam. < 40mm) to be worn as bracelets – even by children, and too large for finger rings. While they may have been worn as pendants, these items, too, could have been decorative fasteners for clothes (Martínez-Sevilla et al. 2021, 826–827).

This may be confirmed by evidence for potential buckles from burial contexts. For example, trapezoidal ›pendants‹ *(Ostrea edulis* valves*)* with perforations, probably originally fastened to clothing, have been found near both clavicles and forearms, on one or both shoulder blades, exceptionally on the pubis and sometimes on, under or near the pelvic bones, near the left elbow or behind the back of skeletons, at the presumed level of a belt (Cantacuzino 1969, 54). In the case of some marble ›bracelets‹, one with four symmetric perforations around its periphery was found on the pelvis of a young individual (of undetermined gender), while several other small examples with two to four perforations were found in adult burials, again possibly having been used as belt buckles (Boncuklu Tarla, Konya Province, Türkiye, Pre-Pottery Neolithic[5] [PPN] B: Kodaş 2019, 11–12 Fig. 10).

Probable bands, straps or leashes shown on figurines could either cover the body directly or be draped over

5 Pre-Pottery Neolithic (PPN)A: 9700–8500 BC; PPNB and PPNC: 8500–6500 BC (after Levy 2018).

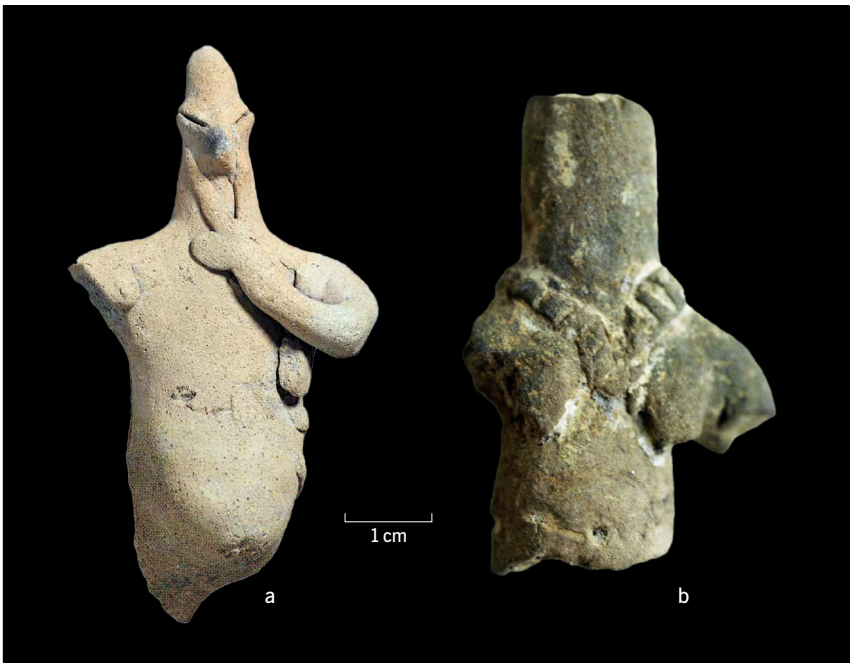



**Fig. 7a–b** a Early Neolithic fragmentary pregnant figurine gesturing with her arm and wearing a band draped down her front; the so-called ›Thinker‹ (Anargyroi, Western Macedonia); b Early Neolithic fragmentary female figurine with applied, incised large clay band around her neck that falls to a V in front (Prodromos, Thessaly).

***Abb. 7a–b*** *a Frühneolithische fragmentierte »schwangere« Figur, die mit ihrem Arm gestikuliert und ein Band trägt, das über ihre Vorderseite drapiert ist; die sogenannte »Denkerin« (Anargyroi, Westmakedonien); b frühneolithische, fragmentarisch erhaltene weibliche Figur mit einem applizierten, eingeritzten breiten V-förmigen Tonband um den Hals (Prodromos, Thessalien).*

clothing. In fact, bands, ribbons, strings or cords – wider than appliqués – seem to be represented. An example is shown around the neck of a fragmentary female figurine from EN Prodromos, Thessaly, Greece (Fig. 7b); another is draped down the front of an EN pregnant female figurine from Anargyroi, Western Macedonia, Greece (cf. Fig. 7a; Adam-Veleni et al. 2017, 185 No. 7). ›Bands‹ appear separately on both shoulders of a figurine from EN Thessaly (Papathanasopoulos 1996, 301 No. 206; Gallis/Orphanidis 1996, 337 No. 285; Orphanidis/Malakasioti 2011, 183 No. 95; 210 No. 148). ›Straps‹ may be held in the hands (Peterson 2016, 136 Fig. 8), as shown by an EN Thessalian figure from Prodromos who carries a container, its prototype possibly made of soft material, without excluding animal hide, on their back (Fig. 8). In rare cases, Early/Middle Neolithic (EN/MN) figurines seem to wear or to be adorned by bands or straps made from animal skins, such as a Thessalian example depicted with two strips marked by rows of rounded dots (felid?) and incised ›paws‹ falling from the shoulders to the middle of the torso over the breasts (Fig. 9; Gallis/Orphanidis 1996, 282; 335; Toufexis 2003, 263 Fig. 29,20)[6]. This interpretation is not inconceivable since the remains of wild carnivores, particularly *Felidae*, have occasionally been found in prehistoric contexts, including domestic ones in Greece (Yannouli 2003; cf. a large, clay, felid head from Vassilika, Central Macedonia, end of MN: Marangou/Grammenos 2005).

**Fig. 8** Early Neolithic fragmentary figure holding straps with both hands, carrying receptacle, imitating a prototype probably made of soft material on their back (Prodromos, Thessaly).

***Abb. 8*** *Frühneolithische fragmentierte Figurine, die mit beiden Händen Riemen hält und ein Gefäß aus weichem Material auf dem Rücken trägt (Prodromos, Thessalien).*

Corporeal forms and details may be emphasised on figurines' body contours by possible complex clothing embellishments. Pointed vertical lines and double or quadruple vertical lines or dots, sometimes bordered by small oblique parallel lines (cf. Fig. 3a–b; cf. Fig. 1a–b), are incised between the armpits and hips, under the arms, or along the hips and legs of LN female figurines from Dikili Tash, Eastern Macedonia, Greece (Marangou 1993, 330 Fig 4a.d; 5; 7; Marangou 2020, 54 Fig. 8). They could represent combinations of applications and beads or decorative textile patterns on tight fitting garments such as dresses, skirts, aprons or leg wraps.

Evidence from personal adornments associated with human burials seems to support hypotheses that connect such represented details to actual clothing. In fact, beads arranged on the side and along a skeleton may show the

6 See also further on possible head coverings in hide. Cf. Levy 2018 on leather sandals.

**Fig. 9** Early or Middle Neolithic figurine torso, hands with incised fingers on the belly, two dotted bands falling on torso, possibly animal hide with four incisions indicating paws (Magoula Bei, Larissa, Thessaly, museum collection).

***Abb. 9*** *Torso einer früh- oder mittelneolithischen Figur, Hände mit eingeschnittenen Fingern auf dem Bauch, zwei gepunktete Bänder, die auf den Torso fallen, möglicherweise Tierhaut mit vier Einschnitten, die auf Pfoten hinweisen (Magoula Bei, Museumssammlung, Larissa, Thessalien).*

edges of garments and thus the shape of garments, as in FN Varna tombs 3 and 43 (Fol/Lichardus 1988, 200; 219). Biconical beads were arranged on the left side along a man's skeleton, while the individual with the most richly furnished grave was buried in clothes trimmed with gold and carnelian beads and circular gold applications (Higham et al. 2007, 644). Impressed dots forming a circular pattern, that decorate the knee of a LN figurine (Fig. 3a–b) are comparable to perforated applications with a row of dotted lines around their edges, possibly sewn on fabric, found at knee level of a FN skeleton (Fol/Lichardus 1988, 200 Fig. 2).

Hanging decorations could also be represented on figurines, as the short vertical parallel lines ending into dots mentioned above (cf. Fig. 3). They could have consisted of joined strands of material, such as on ›fringed/string skirts‹. A similar apparel would have partially covered and partially revealed the lower body according to M. Nikolaidou (2007, 195). A. Melniciuc and A. Kovacs (2019) describe similar ›apron‹ representations of painted or incised fringes – some including applied beads – on the lower body of figurines associated with the Neolithic Cucuteni-Trypillia Culture. It has also been suggested that girdle and neck adornments were not only decorative items but also functioned as sets of dance accoutrements, intentionally manufactured as strung musical rattles, which made body movements audible and maintained rhythm when dancing in ritual situations (Southern Levant, Levy 2018, 41).

Representations of ›fringed skirts‹ on Neolithic figurines were proposed by E. L. Baysal (2019, 142–143 Fig. 8) as a possible parallel to evidence from burials, in particular concerning an example from Hacılar, Burdur Province, Türkiye. In certain neonates-with-mothers burials, *Cyprinidae* teeth with small natural perforations on their roots might have been attached to an apron or string skirt related in particular to women and infants at Vlasac, in the area of the Danube Gorges, Serbia, in the Mesolithic-Neolithic transition (Boric/Stefanovic 2004, 540).

In some cases, marks on the body or face, pigments or tattoos may have been represented. The use of real needles for scarifying (tattooing) the skin has been considered plausible (Nikolaidou 2007, 195). This may explain the two crosses (seen on Fig. 1f) or the circles or lozenges incised on both sides of the lower back of other LN female figurines above their incised »belts« (Marangou 1992a, 357 Fig. 8d; 358 Fig. 9a). This may also account for the parallel incised lines (MN Stavroupoli, Central Macedonia) or the angular

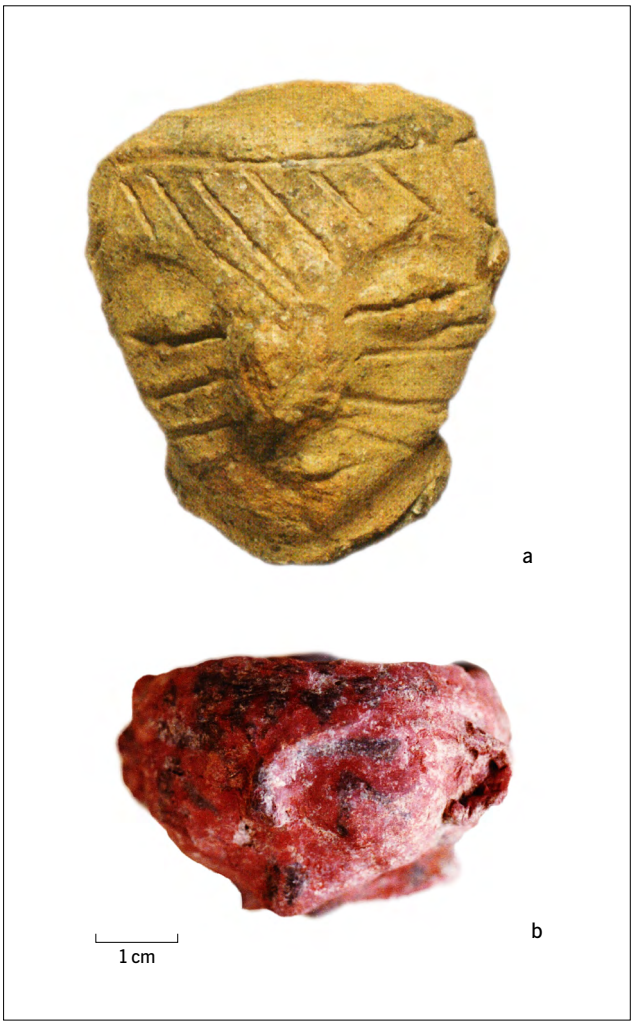



**Fig. 10a–b** a Middle Neolithic head with incised facial features, possible tattoos(?) and headdress (Stavroupoli, Central Macedonia); b Late Neolithic hollow head of a figurine or from an anthropomorphic vessel with painted or tattoo face decoration, ›diadem‹ on the forehead and perforated ears (Dimitra, Eastern Macedonia).

***Abb. 10a–b*** *a Mittelneolithischer Kopf mit eingeritzten Gesichtszügen, möglichen Tätowierungen und Kopfschmuck (Stavroupoli, Zentralmakedonien); b spätneolithische Figurine oder Hohlkopf von einem anthropomorphen Gefäß mit gemalter Dekoration, »Diadem« auf der Stirn und durchlöcherten Ohren (Dimitra, Ostmakedonien).*

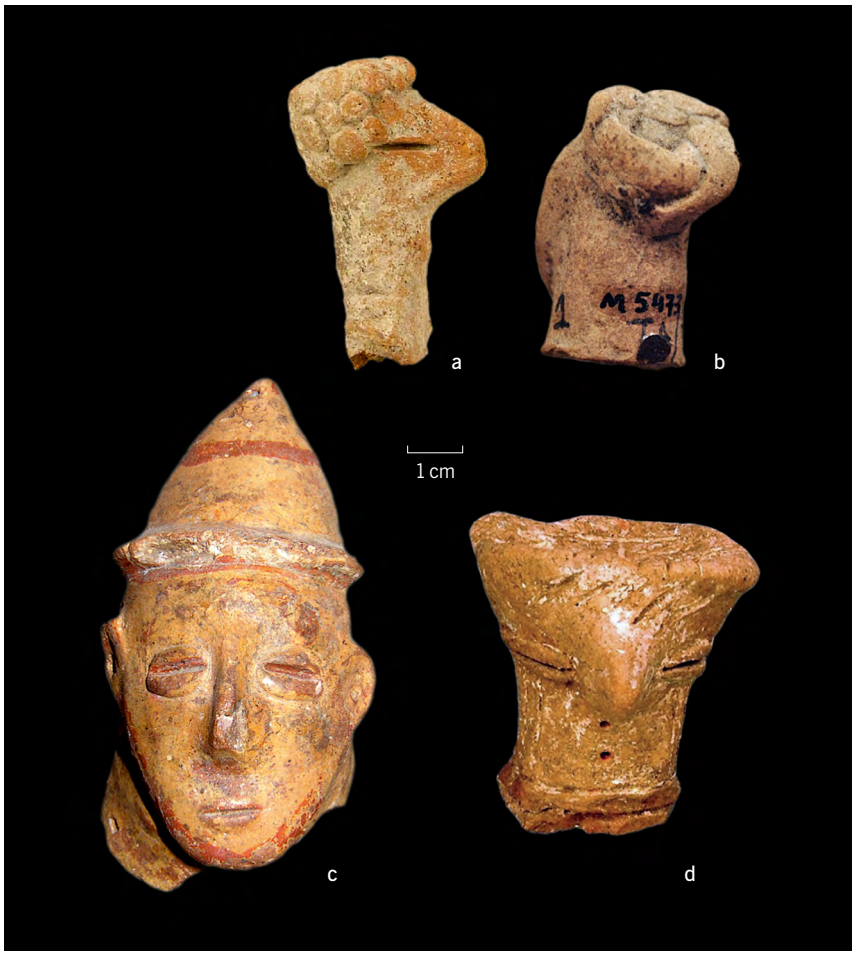



**Fig. 11a–d** a Middle Neolithic head with complex coiffure, possibly beads or perforated shells fixed on cap or hood (Stavroupoli, Central Macedonia); b Early Neolithic head with band around the crown (Prodromos, Thessaly; c Middle (?) Neolithic head with conical hat with brim, possibly in animal hide, and two painted lines around hat from Sofades, Karditsa (Magoula Margarita), Thessaly; museum collection in Volos Athanasakeio Archaeological Museum, Thessaly; d Late Neolithic flattened head with possible matting or cordage head-cover (Stavroupoli, Central Macedonia).

***Abb. 11a–d*** *a Mittelneolithischer Kopf mit komplexer Frisur (Stavroupoli, Zentralmakedonien); b frühneolithischer Kopf mit Band um die Krone (Prodromos, Thessalien); c mittel(?)-neolithischer Kopf mit konischem Krempenhut, möglicherweise aus Tierhaut, und zwei gemalten Linien um den Hut aus Sofades, Karditsa (Magoula Margarita) Thessalien, Museumssammlung, Athanasakeio Archäologisches Museum von Volos, Thesssalien; d spätneolithischer abgeflachter Kopf mit möglicher Kopfbedeckung aus Matten oder Tauwerk (Stavroupoli, Zentralmakedonien).*

or undulating painted motifs (LN Dimitra, Eastern Macedonia) depicted on faces, as on some fragmentary heads (cf. Fig. 10a–b; Marangou 1992a, 420 Fig. 71g; Marangou 1996, 191 Fig. 7; Adam-Veleni et al. 2017, 203 No. 59).

## Headdresses

Marks on the forehead of a MN fragmentary hollow head from Dimitra, Eastern Macedonia, Greece (Fig. 10b), possibly a fragment of an anthropomorphic vessel, instead of pigments or tattoos, may be considered a ›diadem‹ or headdress. Besides possible ›diadems‹, figurines display various other types of headdresses or coiffure, including long strips/braids with horizontal incisions falling from a parting on top of the head, known from EN Prodromos, Thessaly, Greece (Gallis/Orphanidis 1996, 90–91 No. 22–23; 94 No. 26; 104–105 No. 36–37; Papathanasopoulos 1996, 301 No. 206; 312 No. 232), or headbands around the crown, as depicted on another EN figurine from Prodromos (Fig. 11b).

Conical clay hats may also be worn by EN/MN figurines; an example from Thessaly is decorated in a ›spotted‹ pattern, created by carving small, round depressions with a sharp tool (Gallis/Orphanidis 1996, 72 No. 4). Another (possibly MN) example from Thessaly displays a hat with a modelled brim bearing at least five punctuations, painted lines around the brim, halfway up the hat's crown and around the chin, and a perforation on the peak (Fig. 11c; Orphanidis/Malakasioti 2011, 129 No. 1). The ›spotted‹ pattern around the brim of the first example might represent the fur of a wild carnivore (see also above), an indication of individual prestige or status, according to G. Toufexis (2003, 269). Other undecorated conical clay, ›caps‹ – which in some instances may be removable, such as those from Final Neolithic figurines from Aegina, Attica, Greece – would probably be the accessories of seated male figurines (Alram-Stern 2016, Pl. IXa; XIc). Such images were found under the floor of a house, some in miniature vessels, and/or paired with a non-gendered figurine. A large clay LN head whose face displays a series of points below the mouth and multiple perforations through the ears, suggesting non-preserved labrets and earrings, also wears a modelled ›hood‹ on its head, separated by an incised line (Fig. 12). In addition, patterns incised on the crowns of LN figurines with flattened heads (see further) from Central Macedonia could imply a head-covering of cordage or matting (Fig. 11d; Hourmouziadis 1994, Fig 24γ; 25γ; Adam-Veleni et al. 2017, 205 No. 64; cf. 207 No. 71); this might also be an openwork construction, possibly representing twining, or a more rigid basketwork-like structure (cf. Levy 2018, 41).

A LN female figurine head with incised ›hair‹ from Dikili Tash (Marangou 2019, 88, Pl. 81 M1226; Marangou 2020, 50 Fig. 1) displays a unique headdress; this may be attested by an incised, trapezoidal pattern marked with a dot near the periphery of the lower side of the trapezoid, while a ›fringe‹ also falls over the forehead (Fig. 13); more ›hair‹ incisions

**Fig. 12** Large head with modelled and incised headdress and several perforations along the ears and on the mouth (Dikili Tash, Eastern Macedonia, museum collection).

***Abb. 12*** *Großer Kopf mit modelliertem und eingeritztem Kopfschmuck sowie Durchlochungen entlang der Ohren und am Mund (Dikili Tash, Ostmakedonien, Museumssammlung).*

fall under a vertical perforation (ear?), on the front, on each side of the head; two triangular patterns with a dot in the centre (tattoos?) are also incised under the eyes. The depiction of the ›hair‹, including the ›fringe‹ on the front, might, in fact, represent a hairnet, as several dots are marked within and among incisions that indicate the ›hair‹. These may represent (strings of) beads, in the last example sewn onto netting, retained by a ring resembling a perforated *Spondylus* or *Glycimeris*, attached to the hair with a bone pin. Most of the LN/FN artefactual pins of similar types are slightly curved towards their distal tip (Fol/Lichardus 1988, Fig. 143). This form could be explained if these pins were used to attach a circular element or ring of large diameter to a fabric, or to the hair. Moreover, one might also compare the »coiffure« of the MN head from Central Macedonia in Fig. 11a to caps with sewn beads or perforated shells, as described below, besides the similar use of beads in series on ›string skirts‹.

Burial data compare well with the depictions of some figurines' headdresses. In the Franchthi Cave, Peloponnese, Greece, shell ornaments found in a late Mesolithic burial had enlarged perforations around their circumference, suggesting their use as decorative elements, potentially sewn onto garments or caps (Perlès 2018, 187). Evidence from burial sites shows that applications or beads of *Spondylus* shells, arranged in rows on garments, were worn on the deceased person's forehead as a ›diadem‹ (tomb 292 of Cernica, Ilfov County, Romania: Cantacuzino 1969, 14 Fig. 3,5; see also the ornamented clay ›mask‹ in Varna tomb 2: Fol/Lichardus 1988, 222–239 Fig. 26). Several headdresses composed of shells sewn onto caps were found in adult and child burials (Levant, Natufian, 13 500–9600 BC: Levy 2018, 40 Fig. 4,2). Another example comes from the burial of a headless adult female at Vlasac, Danube Gorges, dated after 6200 BC. There, 178 carp-tooth ornaments, most of them perforated in order to be sewn onto a cloak or headdress, were found on both sides of the neck and below the shoulder blades of the deceased (Boric et al. 2014, 23 Fig. 13). According to FN burial evidence from Gradistea Ulmilor, Giurgiu County, Romania (Boian Culture) 24 *Dentalium* beads and two copper ›hairpins‹ as well as a biconical clay object were discovered near the skull of a skeleton (Anghelescu 1955, 311; Comsa 1965, 363). J. Levy (2018, 40) mentions the spacing of gazelle bone beads from a head covering in a child burial from the El Wad Cave, Carmel area, Haifa District, Israel (Natufian Culture 13500–9600 BC), suggesting that they had been attached to a hairnet. Hairnets are attested since the Upper Palaeolithic but are frequently known from the Pre-Pottery Neolithic A, B, and Chalcolithic Levant as representations and artefacts (Levy 2018, 40 and note 14;

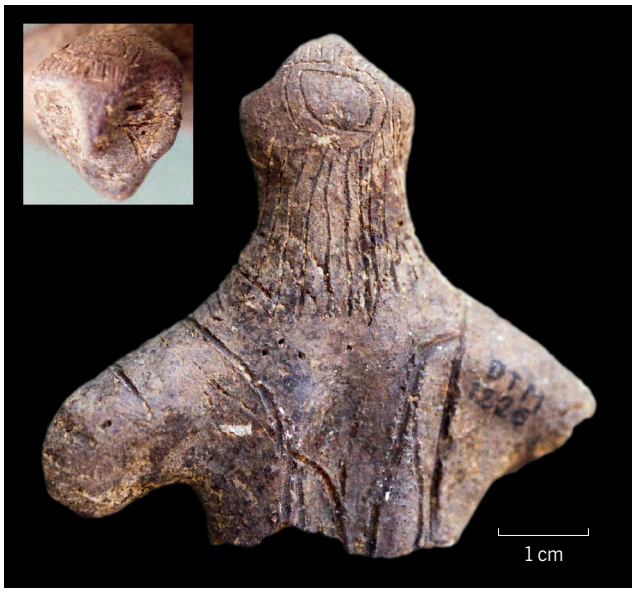



**Fig. 13** Late Neolithic figurine with incised possible hairnet and (clothing?) features on body; incised fringe on the forehead and two triangular patterns (face tattoos or pigments?) under the eyes (Dikili Tash, Eastern Macedonia, museum collection). Back view of body and front of face.

***Abb. 13*** *Spätneolithische Figurine mit möglichem Haarnetz und eingeritzten Merkmalen am Körper sowie zwei dreieckförmigen Mustern (Gesichtstattoo oder Pigmentierungen?) unter den Augen (Dikili Tash, Ostmakedonien, Museumssammlung). Rückansicht des Körpers und Vorderseite des Gesichtes.*

see also Marangou 2020, 30 on ›hairnets‹); netting techniques were already used in fishing, with twisted vegetal cordage and notched net sinkers known since 23 000–25 000 BP (Levy 2018, 40; 47; Adovasio et al. 1996).

## Variations: age and particularities

Ornamentation may be depicted on any anthropomorphs – there seem to be no categories of persons that were excluded from adornment; in particular, the young, the old, and individuals with disabilities[7] would not have been stigmatised.

This is implied by some exceptional representations, such as a well-decorated LN figurine from Dikili Tash (Fig. 14), that may represent a female who potentially suffered from Klippel-Feil syndrome[8], a ›marker of growth disturbance‹, such real cases having been attested in burials[9]. The figurine's standard incised decoration of the body, plausibly representing clothing embellishments, a ›necklace‹

**Fig. 14** Late Neolithic figurine of a woman potentially affected by Klippel-Feil syndrome with incised belt, necklace or cloth accessory, as well as a dotted and incised decoration or folds of clothing on body (museum collection, Dikili Tash, Eastern Macedonia). Front and back view and face.

***Abb. 14*** *Spätneolithische Frauenfigur, die möglicherweise am Klippel-Feil-Syndrom leidet, mit einem eingeritzten Gürtel, einer Halskette oder einem Stoffaccessoire und eingeritzte oder gepunzte Verzierungen am Körper (Museumssammlung, Dikili Tash, Ostmakedonien). Vorder- und Rückansicht sowie vom Gesicht.*

7 Pathological or handicapped individuals are exceptionally represented. For example, the head of a figurine of a ›Down syndrome child‹ from EN Prodromos (Thessaly; Theocharis 1981, 64 Fig. 25), an ›hydrocephalus‹, ›a subject of suffering‹, according to G. Hourmouziadis (1994, 212 Tab. 87 [upper part]), or an individual with trisomy 21, according to A. A. Diamandopoulos et al. (1997).

8 See for example: Wikipedia contributors. (2025, June 15). Klippel–Feil syndrome. In Wikipedia, The Free Encyclopedia, from <https://en.wikipedia.org/w/index.php?title=Klippel%E2%80%93Feil_syndrome&oldid=1295799330> (16.09.2025).

9 A congenital fusion of cervical vertebrae producing a short neck, a low posterior hairline, and a limited movement of the neck, has been attested on an individual buried in LN/FN Alepotrypa Cave in the Peloponnese, southern Greece (Papathanasiou 2005, 382–383 Fig. 6).

**Fig. 15a–b** Late Middle/Early Late Neolithic house model interior and figurines (Platia Magoula Zarkou, Thessaly).

***Abb. 15a–b*** *Spätmittel-/Frühspätneolithisches Hausmodell mit Interieur und Figurinen (Platia Magoula Zarkou, Thessalien).*

around the neck, a ›pendant‹ between the breasts, folds of clothing, a pointed pattern on the lower back, and a hip belt, as in previously described examples, its long hair arriving to its waist, and its facial features do not seem to result from a novice's work (as e.g. Marangou 2024, 83 Fig. 10b). However, the head, with an almost inexistent neck, seems to rest on the trunk, as it may happen due to an abnormal fusion of cervical vertebrae. Another example comes from Dispilio, Western Macedonia; the LN figurine of an old man with probable kyphoscoliosis is shown wearing a (male) accessory: an incised triangular ›apron‹ with a series of circular decorations around the waist (Hourmouziadis 2002, 254–256; Adam-Veleni 2017, 189 No. 17).

The absence of stigmatisation of handicaps is also confirmed in various sub-periods and regions by several special burials of embellished real humans that display pathologies of different kinds and who therefore were not socially segregated; this could possibly also be due to awe or respect (see also Stavreva 2022, 175). The meticulous representation on pathological figurines' clothing, embellishments and/or accessories would seem to reflect this attitude in burial treatment.

Figurines may be adorned regardless of their dimensions, while exceptional cases of combined figurines of different sizes may show age differences of represented humans. An LN scenic clay model of a house interior from the tell Platia Magoula Zarkou, Thessaly, contains several human figures: two ›couples‹ of a standing female and a seated, non-gendered figurine, of different sizes, as well as a smaller, probably younger female. They wear similar ›dresses‹, although the smaller individual was apparently less embellished than the larger ones (Fig. 15; Gallis 1985; Gallis 2022; Alram-Stern 2022). In addition, four very small figurines, one of them possibly also female, with slight differences in shape, size and decoration, could plausibly represent young children (Marangou 2009, Pl. XIh). The scene seems to present stages of childhood, non-gendered versus gendered children and adolescents(?). The smallest

**Fig. 16** Late Neolithic *›Kourotrophos‹*, a woman seated on a seat holding a child with painted decoration (Sesklo, Thessaly, Athens National Archaeological Museum).

***Abb. 16*** *Spätneolithischer* »Kourotrophos«, *eine auf einem Stuhl sitzende Frau, die ein Kind hält, mit aufgemaltem Dekor (Sesklo, Thessalien, Archäologisches Nationalmuseum Athen).*

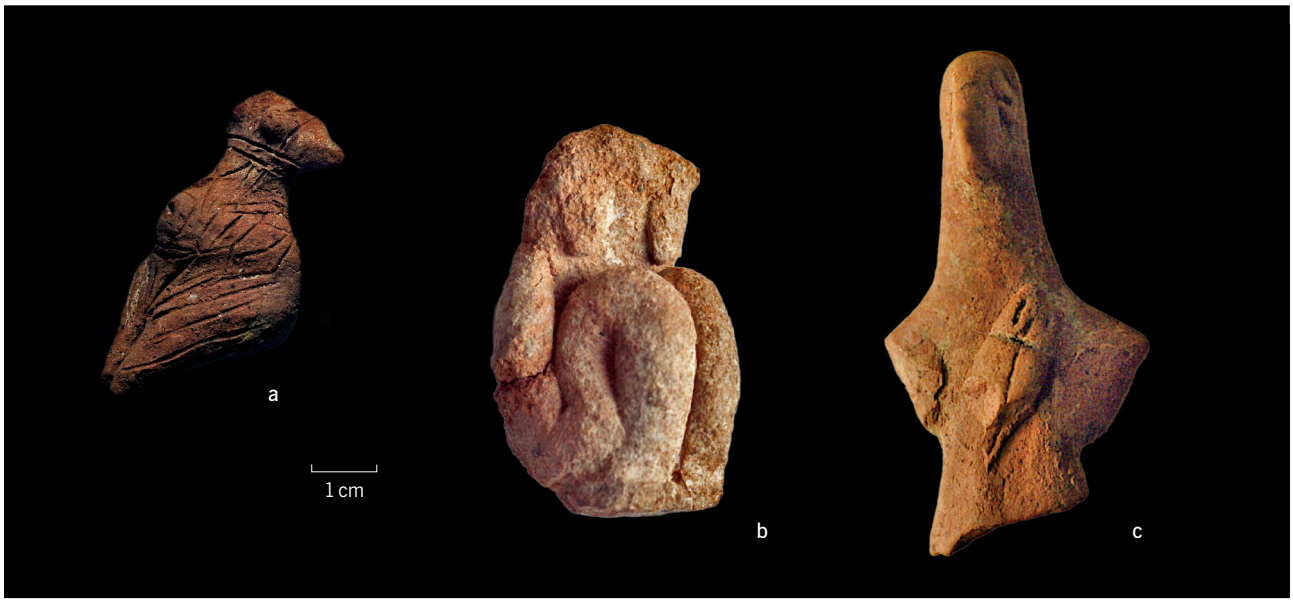



**Fig. 17a–c** Late Neolithic richly ›clothed‹ and decorated pregnant female (Dikili Tash, Eastern Macedonia); b Late Neolithic birth-giving, crouching, nude female (Pefkakia phase II, Thessaly); c Early Neolithic figurine holding on the breast, breast-feeding a probably swaddled infant (Prodromos, Thessaly).

***Abb. 17a–c*** *Spätneolithische, reich »bekleidete« und verzierte schwangere Frau (Dikili Tash, Ostmakedonien); b spätneolithische gebärende, kauernde, nackte weibliche Figurine (Pefkakia Phase II, Thessalien); c frühneolithische Figurine, die wahrscheinlich einen eingewickelten Säugling stillt (Prodromos, Thessalien).*

and more flattened, unstable figurine might possibly represent a swaddled infant[10]. Therefore, the house model could include, besides adults, small females or elder children possibly taking care of younger siblings (three young children or infants and a newborn). None were excluded from personal adornment, although the clothing was differentiated, plausibly due to various young age stages.

Concerning age variation, the use of adornments in burials, including *Spondylus*, does not seem to depend on the gender or age of the deceased, as such objects were also found in burials of adolescents, children, and even infants (Baysal 2019, 148). In Toumpa Kremastis Koiladas, Western Macedonia, almost all of the personal ornaments in a LN group of burials (mainly *Spondylus*) were found with children younger than four years of age (Chondroyianni-Metoki 2022, 343). Neolithic child burials from the wider region, for example, MN (5500/5400–5000/4900 BC) and LN (5000/4900–4500/4400 BC) Hungary, also contained jewellery. In particular, a string of beads 36–45cm long was found on the hips of a three-year-old girl (Anders et al. 2023, 49), while bead girdles were discovered around the waists of three juveniles (Anders et al. 2023, 42). The burial of a one-year-old child in Vlasac (6800–6450 BC) was associated with 701 perforated pieces of carp teeth and 22 shell beads that most likely were originally attached to some kind of burial cloak (Boric et al. 2014, 22 Fig. 11). In late Pre-Pottery Neolithic B (7500–7000 BC) Ba'ja, Southern Jordan, the remains of two three-to-four-year-old children, and two infants, aged between birth and six months, were associated with about 1150 shell and stone beads[11] (Benz et al. 2020, 97 Tab. 1; 99 Fig. 3). The assemblage of beads discovered in the pelvic area of one of the older children could be a belt or a beaded border, therefore the corpses would have been decorated with a ›cloth/clothing/belt with many beads‹ (Benz et al. 2020, 98–99; 101–102)[12]. It may be interesting to examine possible differences of burial treatment concerning cloth covering between infants and children, their treatment indicating specific stages of social embodiment related to age according to D. Boric/S. Stefanovic (2004, 543)[13].

A comparison between *»kourotrophoi«*, female figures holding an infant or child, may also infer the representation of differing clothing in nuanced childhood stages. A LN Sesklo figurine, Thessaly, Greece, of a richly decorated, seated female (whose head is missing; Papathanasopoulos 1996, 307 No. 221) holds a child who seems to be older than a swaddled infant since at least its arms are unwrapped (Fig. 16). The child's surface is richly painted in patterns, spirals, and horizontal bands that are closely comparable to the decoration of the woman holding it; the similarity of their garments may also be an indication that the swaddling period is over. This contrasts with the (probably) swaddled infant held on the breasts by the EN ›breastfeeding‹ female figurine (Fig. 17c) and would suggest that the Sesklo child figurine had already transited to another age

10 This type of figurine is not unique, other examples are known, as from LN Eastern Macedonia, e.g. in Adam-Veleni et al. 2017, 211 No. 79–80.

11 Beneath their crania and torsos, a triangular-shaped space contained aligned shells and cowries, while rows of shells were also found lying on and within their cranial bones, and other beads formed the border of this arrangement. According to M. Benz et al. 2020, the ›beads were probably all sewn onto some kind of cloth, on which the two older children rested and which covered their heads‹ (a cloak?).

12 M. Benz et al. (2020) suggest a differentiation of some sub-adults that could suggest social status even among infants or children.

13 Infants could have been ›wrapped up in layers of (swaddling?) clothes‹, as, for example, attested from anthropological evidence (Boric/Stefanovic 2004, 542 with references).

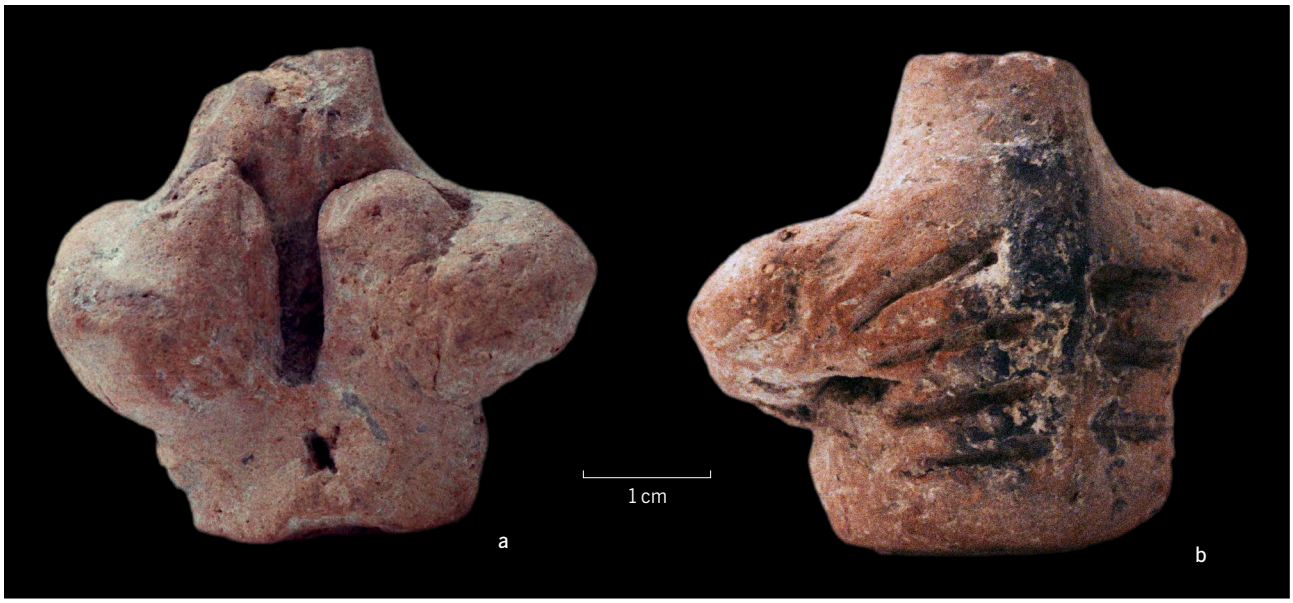



**Fig. 18a–b** Early Neolithic figurine in crouching, birth-giving posture; a front; b back of the figure showing accentuated spinal column (Prodromos, Thessaly).

***Abb. 18a–b*** *Frühneolithische Figurine in geduckter, gebärender Stellung; a Vorderseite; b Rückseite der Figur mit hervorgehobener Wirbelsäulendarstellung (Prodromos, Thessalien).*

stage than that of swaddled infants, as already dressed and decorated differently. Interestingly, the Sesklo child's head, face turned towards the right shoulder of the woman, seems to already display a head deformation, which could confirm the transition to a different than swaddled infant life stage[14]. Besides, its flattened head shape is similar to some examples of adult(?) figurines' ›deformed‹ heads, possibly wearing a particular matting or basketwork head cover (cf. Levy 2018, 4; for Near East iconographic parallels), as described above (cf. Fig. 11d, LN Stavroupoli, Central Macedonia; Adam-Veleni et al. 2017, 207 No. 71; LN, Thessaloniki region, surface find). The latter type of flattened head examples originates from areas with close relationships concerning LN figurines typology (Adam-Veleni 2017, 211 No 80, described by E. Stefani), and where ›swaddled infants‹ figurines (see above, footnote 10), similar to the above described, Platia Magoula Zarkou example, were also found.

Different nuances of the term ›anthropomorphic‹ may be distinguished on clothed or covered figurines, suggesting various age- and life-stages. But it remains to be explained why certain figurines do seem to wear nothing.

## Nudity with nuances

In the rare cases when complete or partial nudity would be necessary in real-life situations, it also appears on figurines[15]. This is attested by images of the birth-giving process (as in Fig. 17b; Fig. 18)[16], and similarly during breastfeeding (cf. Fig. 17c; Koukouli-Chrysanthaki et al. 2007, 74 Fig. 56; 58; Adam-Veleni et al. 2017, 209 No. 74; see also breastfeeding figurines in Biehl 2015, 194 Fig. 10,5; 197 Fig. 10,8; 198 Fig. 10,9). The spinal column on the back of nude, birth-giving figurines may be accentuated (cf. Fig. 18b)[17]; the figurine is crouching, a typical birthing position (Papageorgiou 2023, 47–48), particularly in the past. The depiction of the old male with probable kyphoscoliosis mentioned above shows a similar accentuation of his bent spine, apparently also due to his hunched posture. While generally not shown on common nude figurines, the marked spine and bent back may also seem to convey pain or suffering (for different reasons) in both these cases.

Nudity is also depicted in the Neolithic, often in EN standard postures of naturalistic clay figurines of males from Sesklo (e.g. Papathanasopoulos 1996, 298 No. 203) and females from Otzaki Magoula (e.g. Papathanasopoulos 1996, 299 No. 204). The EN or MN so-called ›twins‹, siblings or couple(?), or otherwise closely – without excluding socially – connected persons, from Domeniko, Thessaly, Greece, provide another example: two genderless nude figures standing close together, touching at the buttocks' level and embracing (Papathanasopoulos 1996, 314 No. 234). Furthermore, several FN figurines from Thessaly are ›acrolithic‹ (equipped with a stone extremity); they have schematic, mostly crude clay bodies (Fig. 19a; Fig. 20a), to which elaborately decorated stone heads are added (reconstruction: cf. Fig. 19b)

14 The swaddling process starts immediately after birth and may last for months or up to at least one year; if the infant reposes on a hard surface, such as wooden boards, it may provoke a widened cranium deformation (Marangou 2010, 18 Fig. 2,20 with references).

15 In contrast to pregnant females, often depicted as richly clothed (cf. Fig. 17a).

16 Gimbutas 1989, 196 Fig. 7,46; Weisshaar 1989, Pl. 66,13.17,2; Marangou 1992a, 34; 264; Pl. 13m; Gallis/Orphanidis 1996, 198–199 No. 143–144.

17 On accentuated spinal columns cf. Meskell/Nakamura 2005, 168 Fig. 83; Huth 2008, 493 Fig. 1; Schmidt 2013; Mauer/Zierhofer 2020.

(e.g. Papathanasopoulos 1996, 305 No. 216–217, FN). They are predominantly non-gendered although, exceptionally, females with accentuated breasts occur (Marangou 1992a, 423 Fig. 74d). In contrast to the Thessalian figures' crudely-modelled, ›nude‹ bodies, the stone heads are carefully worked and even elaborately painted.

It is possible that these figurines were not intended to be permanently nude; missing elements and lost organic materials such as textiles, wood, feathers, or cereal grains may have covered or been attached to them. For example, various cereal grains are imprinted (deliberately?) on seemingly precise locations on the surface of an acrolithic genderless clay body from FN Rachmani, Thessaly, Greece (cf. Fig. 19a; Marangou 1992a, 423 Fig. 74c). Even if this happened unintentionally, due to figurines being modelled in spaces containing grain, clay pellets imitating individual grains are known; they may decorate shoulders, arms or hips of figurines (Gimbutas et al. 1989, 366; Pl. 8,1.1; Gallis/Orphanidis 1996, 211 No. 154; 335 No. 282) or represent eyes (Adam-Veleni et al. 2017, 185 No. 7; Orphanidis/Malakasioti 2011, 135 No. 10; 212 No. 151). The latter were formerly called ›coffee-bean eyes‹ (Hourmouziadis 1994, 247 footnote 20; Pl. 16b). It is also possible that lost elements, such as feathers or real grains, including those arranged in a series, may have been used as ornaments on figurines and worn by humans (Marangou 1992a, 142; cf. Kyparissi-Apostolika 1992, 187; Hourmouziadis 1994, 220–221), perhaps even attached to garments or clothing.

Interestingly, a few thousand fossilised grains of *Lithospermum purpureo-coeruleum* – more than a hundred of them perforated at one or both ends (of the grain) – were found in a hemispheric vase (Ulmeni tell, Gumelniţa A1 Culture; Carciumaru 1985). The vase also contained about 190 (intact or fragmentary) red ochre or white-coloured terracotta beads, some of them perforated, as well as about 200 microlithic quartzite tools, some seemingly used for cutting and perforating. The ensemble could correspond to a bead-making process: perforated grains and terracotta beads, each measuring a few millimetres, would have been combined to form ›necklaces‹ (Carciumaru 1985; Marangou 1992a, 143). A comparable use of perforated grains of the same species as strung beads has been proposed for other finds, such as an ensemble of over 600 grains from Kodjadermen (Gumelniţa Culture; Carciumaru 1985, 2).

Furthermore, there are acrolithic figurines bearing woven textile imprints (cf. Fig. 20) on their clay torso and/or abdomen (Marangou 2009, 89; Pl. XIIIb–c; Marangou 2020, 39–40 Fig. 10; cf. Hansen 2007, 276 Fig. 170), but not under their flat base, as would be the case if the figurine was simply stabilised on a textile during modelling (as it happens with pottery). In addition, a fragmentary schematic (›stylised‹) upper part of a figurine (no gender indication visible – male?) from the site of Ulucak, İzmir Province, Türkiye (level Vb, 6500–6000 BC), discovered in association with 22 spindle whorls and a stamp, still bore an actual textile fragment on the left shoulder, extending to the torso (Cilingiroglu 2009, 17 Fig. 7). This ›textile piece was executed as a plain weave made with one warp and one weft; it is impossible to tell whether the figure had been clothed or simply kept wrapped in a cloth‹ (Cilingiroglu 2009, 15). While a functional use of textiles, – such as during clay modelling – cannot be completely excluded (Schoop 2014, 426; Marangou 2020, 40), the evidence may also imply an application of body coverings, possibly before completely drying the figurine. In any case, the presence of textiles conceivably suggests their occasional removal or replacement (Marangou 2020, 13; 15).

## Significant domestic contexts of anthropomorphic figurines

Actual adornments, especially in shell, mainly beads, pierced shells, or *Spondylus* bracelets and bone pins, occur in the context of figurines and miniatures, as on the LN site of Dimitra, where bangles or beads, mostly made of shell, were attested in 26 of their 34 studied domestic figurines' contexts (Marangou 1997, 243). In LN Dikili Tash, real jewellery is included in seven of the ten known domestic asso-

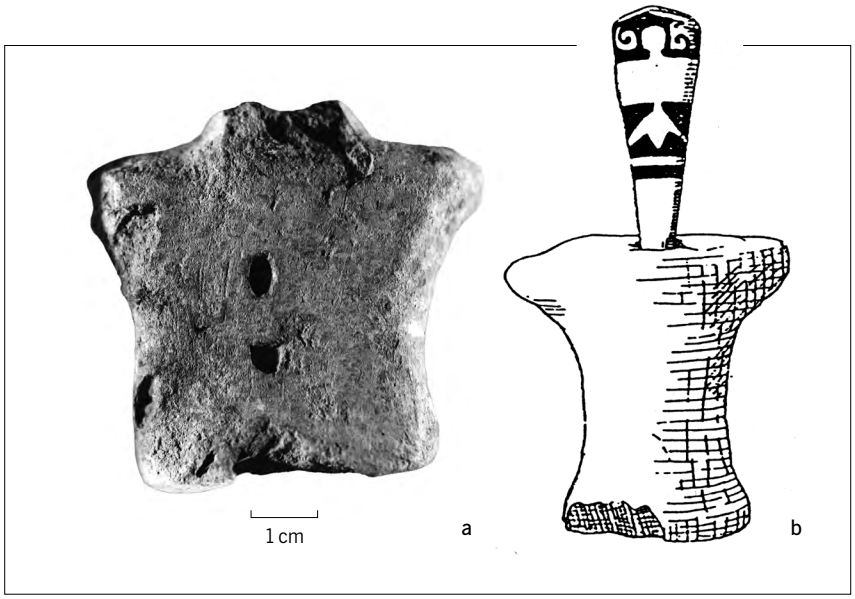



**Fig. 19a–b** Final Neolithic non-gendered acrolithic body with grain imprints (Rachmani, Thessaly); b reconstruction of Final Neolithic acrolithic figurine (Thessaly).

***Abb. 19a–b*** *Endneolithischer, nicht genderspezifischer akrolithischer Körper mit Kornabdrücken (Rachmani, Thessalien); b Rekonstruktion einer endneolithischen akrolithischen Figurine (Thessalien).*

**Fig. 20a–c** Final Neolithic non-gendered acrolithic body with textile imprints (Tsangli, Thessaly).

***Abb. 20a–c*** *Endneolithischer akrolithischer Körper mit Textilabdrücken (Tsangli, Thessalien).*

ciations of figurines (Marangou 1992a, 421 Fig. 72g), which include a male with a belt and application. All but one were embellished with represented attributes. Therefore, in at least some cases, genuine personal ornaments were found in direct association with clay figurines; in these examples, most of them would also have been ornamented with representations of similar ornaments. The links of Neolithic figurines with adornment (represented or real) that possibly suggest gender or status seem to be tight.

Besides personal ornaments, figurine contexts include food storage areas, such as clay silos containing grains of wheat or lentils, and food preparation areas, such as hearths. Figurines were found close to a quern and a hearth, as well as near a storage space at the site of Dimitra II (MN) and III (LN; Marangou 1997), among other sites in the Balkans (Marangou 1992a, 222–224). Figurine contexts also include objects associated with textiles, such as weaving and spinning tools, spindle whorls or loom weights (Marangou 2020, 40–41). For example, a schematic figurine was found on a pile of 28 clay loom weights on a house's clay bench next to a hearth (House 4 of Piscul Cornisorului, Sălcuța III Căușeni District, Romania; Marangou 1992a, 223 Fig. 26a–b with references); elsewhere, a ›cult scene‹ with figurines and ›temple‹ models was found near a vertical loom on the second floor of a building, also comprising a clay ›altar‹ (Radingrad, Karanovo IV or V, Sliven Province, Bulgaria; Gimbutas 1982, 251). In Rachmani, acrolithic genderless figurines were found in a house containing 22 spindle whorls, various grains and tools (Wace/Thompson 1912, Fig. 28 ), while spindle whorls and female figurines were found together (Marangou 2020, 40; with more references) in Dikili Tash and Franchthi. In at least some sites, female figurines seem to be rather connected to food preparation and spinning, while non-gendered figurines are associated with storage and weaving (Marangou 2020, 40).

Spinning or weaving tools assembled in significant numbers, if not simply indicating a specialised fabrication area, might also convincingly imply groups of women working together in certain spaces, also containing figurines. At the same time, the proximity of figurines and other symbolic objects to hearths, the centres of everyday life, has been emphasised (Marangou 1992a, 222). Parallel activities, utilitarian and intangible, are also implied by miniature representations, both functional and symbolic (Marangou 2024, 69). While working collectively, women could have sung to the rhythm of the loom, told tales or recounted actual events; such activities seem to have been practised quite early (Marangou 2020, 42) and till the recent past.

## Changing appearances

The appearance of Neolithic figurines was not necessarily static. They may have undergone specific alterations, changing not only hats (e.g. FN Aegina figurines discussed above) or garments but also heads – as in a case from the FN site, Rachmani. Here, five stone heads, four clay torsos and two fragments were discovered together in house Q; at least two stone heads (one decorated, the other without preserved decoration) could fit the holes of torsos, but they were found separately – not fixed in any clay body – in their last use[18]. Different decorated heads could have been fixed to ›neutral‹ bodies, as suggested by the reconstruction in Fig. 19b, differentiating them and so individualising (Marangou 2009, 89–90), or periodically changing their identity (Marangou 2020, 32).

18 Wace/Thompson 1912, 43 Fig. 25a–c; 28g; Marangou 1992a, 143; Marangou 2009, 73; Marangou 2020, 32.

Moreover, the figurines' faces could plausibly be changed. A female, according to S. A. Luca (2014), LN standing figurine from Liubcova, site Vinča C, Banat, Caraș Severin County, SW Romania, wears a ›tunic‹, close-fitting ›trousers‹, and a pendant or fibula ›fastens‹ its ›shirt‹ on the front and on the back (Fig. 21). Its head is broken and the arms are perforated. It holds a mask in its left hand on the shoulder and an *askos* (a globular clay vessel) in the right on its hip (Luca 1990; Luca 2014); it would have been found together with other anthropomorphic and zoomorphic figurines in a burnt building (Horvath 2010, 121). Interestingly, the figurine's body incisions are inlaid with white, while the mask's incisions are highlighted with red paste, clearly indicating that the mask changed the figurine into a different entity (Marangou 2009, Pl. XIVd; Marangou 2020, 51 Fig. 3). ›Masked‹ figurines examples are also attested elsewhere, such as a MN removable, lozenge-shaped mask belonging to a pillar-headed figurine from Achilleio, Thessaly, Greece (Gimbutas 1989, 359, Pl. 7,17).

Besides figurine representations, life-size masks are well attested since the beginning of the Neolithic period and even earlier. They may be anthropomorphic, zoomorphic, or hybrid and made of stone, bone, and clay (Marangou 2009, 11–13 with references; 2020, 32–34). A striking example is the partial anthropomorphic mask made from elk antler (Fig. 22) (Kostyleva et al. 2001; Marangou 2009, Pl. XIVa–c; Marangou 2020, 51 Fig. 4), found together with wild animal bones and clay sherds in a pit dated to the 4th millennium BC in the Upper Volga plain (Volosovo Neolithic Culture). Hollowed out internally and equipped with perforations for securing it, the mask has a high forehead with a detailed nose and eyebrows and would have covered the upper part of a human face. Neolithic human skeletons buried close to the (possibly ritual) pit show similarities to the mask's forehead and nasal proportions (Kostyleva et al. 2001).

A temporary change of face, head (covering), or garment implies the possibility of variation in the role, gender, or status of human beings. This may indicate ambiguity and/or fluidity, emphasise alternative readings of the depictions, and generally denote performance. The possibility of varied narratives suggesting continuous fluidity of role, status, or social gender of figurines, and therefore of real or fictive persons does not seem inconceivable. Among other possibilities, such a change could materialise transitional procedures such as initiations or signal depictions of imaginary beings. In oral traditions, narratives of tales or past events can change each time they are transmitted. Material objects may be employed, either in flexible combinations of figurative representations (Marangou 1996; Marangou 2009) or by transformations of heads, faces, attire or coverings (Marangou 2020), to alter connotations or contents related to identity, gender, or social role. This interpretation presupposes the participation of ›knowers‹ such as ritual specialists, connoisseurs, or wise men and women using material means – including figurines – to transmit narratives or/and carry out performances.

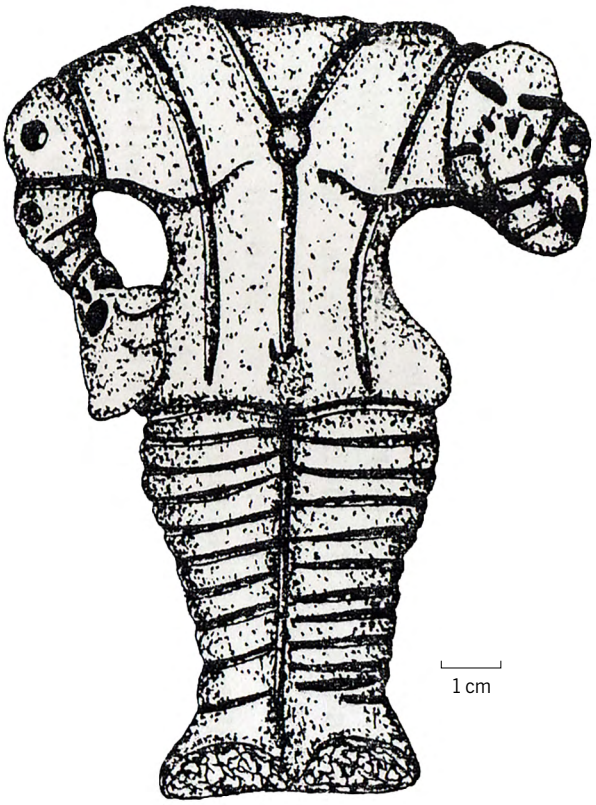



**Fig. 21** Late Neolithic, clay figurine from Liubcova, holding a mask in the left hand and a vase *(askos)* in the right one.

***Abb. 21*** *Spätneolithische Tonfigur aus Liubcova, die in der linken Hand eine Maske und in der rechten Hand ein Gefäß* (askos) *hält.*

## Conclusions

In Neolithic Greece, particularly in Macedonia, Thrace and Thessaly, various ways of draping, clothing, or covering, which combined deliberately selected adornment and functional aspects, were represented on clay anthropomorphic figurines from domestic contexts as examined in this paper. In an attempt to identify and interpret such characteristics as a depiction of possible components of actual human appearance related to clothing or garments, reference was also made to artefacts – suggested prototypes of the representations – as attested from Greek Neolithic domestic and burial contexts, as well as parallels from Southeastern Europe and the Near East.

Body-, limb-, and head-coverings, facial or corporeal markings and the physical characteristics accentuated on represented beings would have been highly meaningful. The differentiation of coverings may depend on the figurine's gender or age, but there appears to be no exclusion from adornment in cases of human difference or disability. Nudity is represented in nuanced ways, including in particular life situations, such as giving birth.

Elements imitating real features may be present and/or emphasised, missing and/or invisible. Attachments made of perishable materials may have been originally present – either permanently, temporarily or periodically. Changes in the appearance of figurines (also suggesting modifications of human appearance) may be attested by the evidence for alternative head coverings, masks, or heads; figurines' body

**Fig. 22a–c** Eneolithic life-size, elk antler partial mask (Veselinovo Culture, Sakthtych, North-Western Russia).

***Abb. 22a–c*** *Äneolithische lebensgroße Teilmaske aus Elchgeweih (Veselinovo-Kultur, Sakthtych, Nordwest-Russland).*

coverings and clothing may be implied by non-preserved or impermanently used artefactual elements. This evidence corroborates the likelihood of fluid scenarios during the use of figurines, involving their identity, transitional stages or narratives, in addition to their plausible movements and varying combinations as material objects.

Figurines as physical artefacts may be perceived as material aids used in everyday life and representing it, while a female involvement may be suggested from attested, related domestic activities. At the same time, with their iconographic features, they may also refer to symbolic practices and processes. They may have participated in an intangible transmission of messages or narratives, possibly intervening between real or fictive *personae* or within social groups. In an imaginary world, human depictions and fiction, concrete features and intangible conceptions may have been combined without clear frontiers. Considering the nuances of covering and nudity in figurines' appearance may lead to perceptions alluding to concrete and symbolic aspects of the ›Stone Age history of clothing‹. ›Reading‹ the appearance of the figurines as perceived and understood by their creators and users, with their deeper meanings and nuances, constitutes a continuing challenge to our understanding and interpretation of Neolithic ›coverings‹ and nudity.

## Acknowledgements

The author wishes to warmly thank the organisers of the 17th Archaeological Conference of Central Germany for their kind invitation to contribute to a most important and interesting congress. Sincere thanks are also due to the referees for their precious comments. Warmest thanks are due to the Greek Ephorates of Antiquities, Museums and excavators for having permitted the study and publication of their material.

For permission to reproduce photographs from their publications and materials, sincere thanks are also due to:

Fig. 7a: The Thessaloniki Archaeological Museum and Dr. Panikos Chrysostomou, Director of the Ephorate of Antiquities of Florina, Director of the Anargyroi excavations,

Fig. 9: The Ephorate of Antiquities of Magnesia and the Research Centre for Antiquity of the Academy of Athens and its director, Dr. Victoria Sabetai,

Fig. 10a: The Thessaloniki Archaeological Museum, as well as Dr. Dimitrios Grammenos, Honorary Ephor of Antiquities, Former Director of the Thessaloniki Archaeological Museum and Dr. Stavros Kotsos, Ephorate of Antiquities of the City of Thessaloniki, Directors of the Stavroupoli archaeological excavations,

Fig. 11a: Dr. Dimitrios Grammenos, Honorary Ephor of Antiquities, Former Director of the Thessaloniki Archaeological Museum and Dr. Stavros Kotsos, Ephorate of Antiquities of the City of Thessaloniki, Directors of the Stavroupoli archaeological excavations,

Fig. 11c: The Ephorate of Antiquities of Larissa,

Fig. 11d: Dr. Dimitrios Grammenos, Honorary Ephor of Antiquities, Former Director of the Thessaloniki Archaeological Museum and Dr. Stavros Kotsos, Ephorate of Antiquities of the City of Thessaloniki, Directors of the Stavroupoli archaeological excavations,

Fig. 15a: The Austrian Academy of Sciences Press,

Fig. 15b: The Museum of Cycladic Art in Athens – Nicholas P. Goulandris Foundation,

Fig. 16: The National Archaeological Museum in Athens.

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# Cloak, belt, and loincloth. 10th–9th millennium BC depictions of clothing from Göbekli Tepe and other Upper Mesopotamian sites

Oliver Dietrich

**Zusammenfassung**

Mantel, Gürtel und Lendenschurz. Darstellungen von Kleidung aus dem 10. bis 9. Jt. v. Chr. aus Göbekli Tepe und anderen obermesopotamischen Fundstätten

*Funde von erhaltenen Textilien sind seltene Ausnahmen im frühen Neolithikum (Akeramisches Neolithikum, PPN, 9600–7000 v. Chr.) Südwestasiens. Die meisten Belege stammen von bildlichen Darstellungen. Die bei weitem größte Ansammlung solcher Darstellungen ist von Göbekli Tepe, Provinz Şanlıurfa im Südosten der Türkei bekannt, hauptsächlich in Form von Reliefs auf den bis zu 5,5 m hohen, T-förmigen Kalksteinpfeilern, die integraler Bestandteil der Gebäude der älteren Bauphase der Stätte sind. Der Ausgräber K. Schmidt identifizierte die Pfeiler überzeugend als anthropomorphe, stilisierte Darstellungen menschlicher Körper, nicht zuletzt, weil einige der Reliefs Kleidung in Form von Gürteln und Lendenschurzen zeigen. Schmidt machte auch auf eine häufige Darstellung auf ihren Vorderseiten aufmerksam: zwei parallele vertikale Bänder, die er als stolaähnliches Gewand identifizierte. Hier wird eine nuancierte Interpretation vorgeschlagen: Es werden Argumente vorgebracht, um die Identifizierung dieses Merkmals mit den Säumen langer Gewänder zu untermauern. Dies führt zu einer neuen Interpretation der Tiere, die häufig auf den Seitenflächen der Pfeiler abgebildet sind – sie befinden sich auf den Gewändern und beziehen sich wahrscheinlich auf gestickte oder mit Farbe auf die Kleidungsstücke aufgebrachte Darstellungen. Der vorliegende Beitrag wird nicht nur die Art der in Göbekli Tepe dargestellten Kleidung untersuchen, sondern auch ihre Bedeutung, die wahrscheinlich im Bereich der Paraphernalia für schamanische Rituale anzusiedeln ist.*

**Schlagwörter** Südwestasien, Akeramisches Neolithikum, Göbekli Tepe, Kleidung, Schamanengewand

**Summary**

*Finds of preserved textiles are rare exceptions in the Early Neolithic (Pre-Pottery Neolithic, PPN, 9600–7000 BC) of south-west Asia. Most of the evidence comes from imagery. The by far largest assemblage of such depictions is known from Göbekli Tepe, Şanlıurfa Province, in south-eastern Turkey, mainly in the form of reliefs on the up to 5.5 m high, T-shaped limestone pillars that are integral parts of the buildings of the site's older construction phase. The excavator, K. Schmidt, convincingly identified the pillars as anthropomorphous, stylised depictions of human bodies, not least because some of the pillars include reliefs of clothing in the form of belts and loincloths. Schmidt also drew attention to a common depiction on their front sides: two parallel vertical bands, which he identified as a stole-like garment. Here, a nuanced interpretation is put forward: arguments are presented to substantiate the identification of this feature with the hems of long gowns. This results in a new interpretation of the animals frequently shown on the lateral faces of the pillars – they are located on the gowns and probably refer to embroidered or stamped ornaments. The present contribution will explore not only the form of the clothes represented at Göbekli Tepe but also their meaning, which can likely be pinpointed to the realm of paraphernalia for shamanic rituals.*

**Keywords** South-west Asia, Pre-Pottery Neolithic, Göbekli Tepe, clothing, shaman costume

## Introduction

Finds of preserved textiles are rare exceptions in the Early Neolithic (Pre-Pottery Neolithic, PPN, c. 9600–7000 BC) of south-west Asia (Bar-Yosef 2020)[1]. Evidence from PPNA Jerf el Ahmar, Aleppo Governorate, Syria, and Körtik Tepe, Diyarbakır Province, Turkey, in both cases in the form of alleged textile imprints, is disputed (Bender Jørgensen et al. 2023). Remains and imprints of textiles, baskets, and mats have been reported from PPNB graves at Tell Halula, Raqqa Governorate, Syria (Alfaro Giner 2012). Fragments of baskets, linen yarns and fabrics, as well as ropes, have been discovered in the Nahal Hemar Cave, Southern District, Israel (Schick 1986; Shamir 2020), where an assemblage of PPNB ritual objects, including plastered skulls, plaster sculpture and a mask, was discovered (Goren et al. 1993). Woven textile and basketry fragments from Çatalhöyük, Konya Province, Turkey (Burnham 1965; Mellaart 1967, 218–220) have

1 The earliest, pre-PPN evidence from the region would be the possible fibre fragments interpreted as remains of cordage from Ohalo II, Northern District, Israel, some 19 000 years old (Nadel et al. 1994). Recently, perforated pebbles from the Natufian settlement of Nahal Ein-Gev II, Northern District, Israel, have been identified as possible spindle whorls (Yashuv/Grosman 2024).

**Fig. 1** A clay figurine from Nevalı Çori, south-eastern Turkey. The person is wearing a broad, dotted loincloth/belt, possibly a leopard skin. Belts are restricted to male figurines at the site. Whether this implies that belts, also present – for example – on some pillars at Göbekli Tepe, are generally exclusive to males remains open.

***Abb. 1*** *Eine Tonfigurine aus Nevalı Çori im Südosten der Türkei. Die Person trägt einen breiten, gepunkteten Lendenschurz/Gürtel, möglicherweise ein Leopardenfell. Gürtel treten an diesem Fundort nur bei männlichen Figurinen auf. Ob dies bedeutet, dass Gürtel, die zum Beispiel auch auf einigen Pfeilern in Göbekli Tepe zu sehen sind, generell nur von Männern getragen wurden, bleibt offen.*

**Fig. 2** A sculpture (ht. 66 cm) found face-down in one of the younger, 9th millennium BC buildings at Göbekli Tepe. The person is depicted standing with the arms bent at the sides of the body, hands lying side by side on the stomach, and wearing cap-like headgear that exposes the ears. The face is heavily sintered and difficult to judge, but there are indications of a beard. The gaze is directed upwards. Gender and legs are not specified; the sculpture ends in a conical peg.

***Abb. 2*** *Eine Skulptur (H. 66 cm), die mit dem Gesicht nach unten in einem der jüngeren Gebäude aus dem 9. Jt. v. Chr. in Göbekli Tepe gefunden wurde. Die Person ist stehend mit seitlich angewinkelten Armen dargestellt, die Hände liegen nebeneinander auf dem Bauch. Sie trägt eine mützenähnliche Kopfbedeckung, bei der die Ohren frei bleiben. Das Gesicht ist stark versintert und schwer zu beurteilen, aber es gibt Hinweise auf einen Bart. Der Blick ist nach oben gerichtet. Geschlecht und Beine sind nicht angegeben; die Skulptur endet in einem konischen Zapfen.*

recently been identified as being made of oak, elm and willow/poplar bast instead of the flax assumed earlier (Rast-Eicher et al. 2021; Loudon et al. 2023). These finds dating to the first half of the 7th millennium are currently regarded as the earliest preserved woven textiles (Bender Jørgensen et al. 2023).

Additional – and in fact, most – evidence for PPN clothing comes from imagery, be it the leopard skins shown on anthropomorphic clay figurines from Nevalı Çori, Şanlıurfa Province, Turkey (Fig. 1; Morsch 2002; Morsch 2017), on the murals at Çatalhöyük (Mellaart 1967, 218–220) or the apparent skirt-like items depicted on some figurines (Beuger 2019). However, the by far largest assemblage of depictions related to clothing and specific garments comes from the limestone sculptures and the T-shaped pillars that are ornamented by bas-reliefs discovered at sites like Nevalı Çori and Göbekli Tepe (Fig. 2) in south-eastern Turkey[2]. The pillars present

2 Hauptmann 1993; Hauptmann/Schmidt 2007; Schmidt 2010; Dietrich et al. 2019; Dietrich 2024.

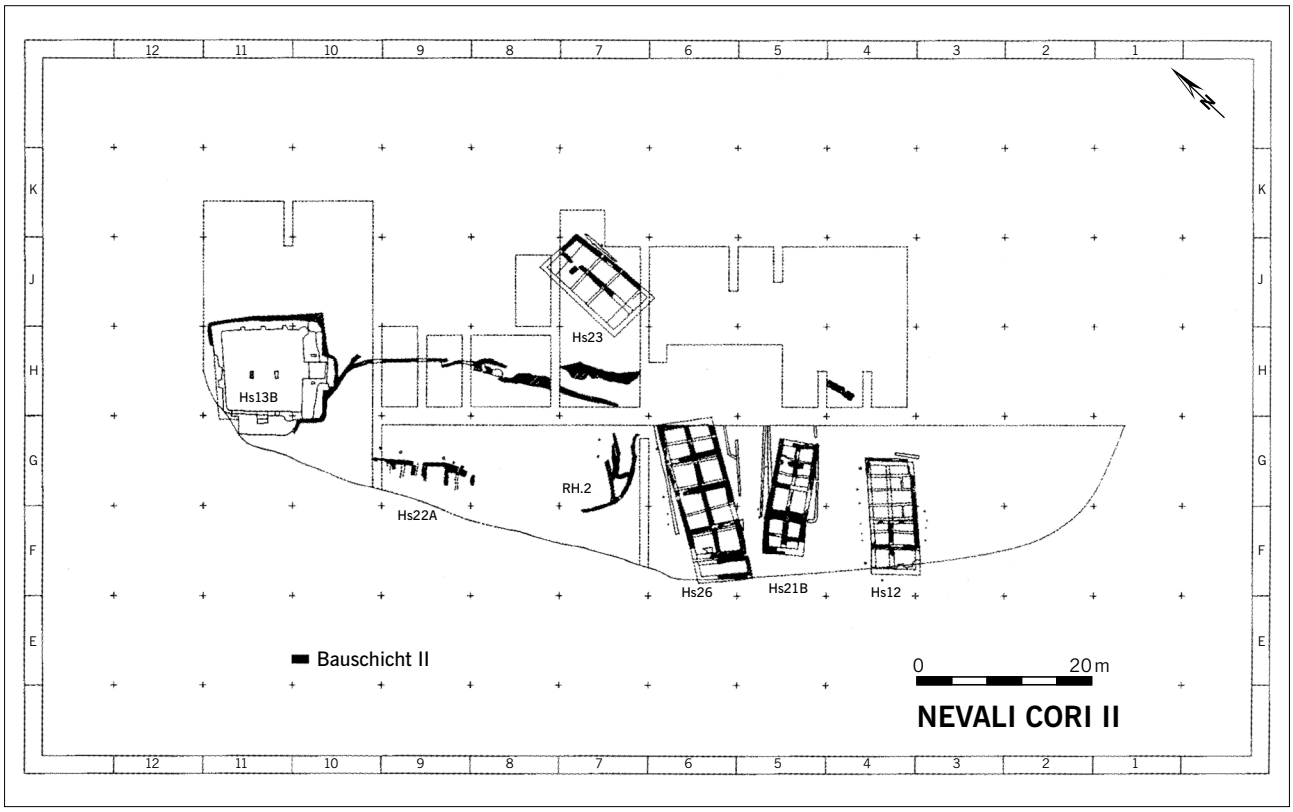


**Fig. 3** Plan of the excavations at Nevalı Çori, layer II. The site was excavated by H. Hauptmann between 1983 and 1991 in the run-up to the construction of the Atatürk Dam and produced Early and Middle PPNB domestic architecture as well as one ›special building‹. In the image, the so-called channel houses, which divide into a small space for dwelling and a cool and dry storage area with underfloor channels, are clearly visible.

***Abb. 3*** *Plan der Ausgrabungen in Nevalı Çori, Schicht II. Die Fundstelle wurde zwischen 1983 und 1991 von H. Hauptmann im Vorfeld des Baus des Atatürk-Staudamms ausgegraben und erbrachte Wohnarchitektur des frühen und mittleren PPNB sowie ein ›Sondergebäude‹. Auf dem Bild sind die sogenannten Kanalplan-Häuser gut zu erkennen, die sich in einen kleinen Raum zum Wohnen und einen kühlen und trockenen Lagerraum mit Unterbodenkanälen aufteilen.*

the most expressive imagery of garments and will be the focus of this overview.

## Nevalı Çori and Göbekli Tepe

Excavated by H. Hauptmann between 1983 and 1991 in the run-up to the construction of the Atatürk Dam, the settlement of Nevalı Çori is located in the foothills of the Taurus mountains; it extends on both banks of the Katara, a tributary stream of the Euphrates[3]. The tell site revealed five occupation layers assigned to the Early and Middle PPNB, which were sealed by Halaf Period and Early Bronze Age deposits. The architecture of settlement layers I–IV is characterised by the so-called channel house type, first described at Çayönü, Diyarbakır Province, in the Turkish Tigris region (Erim-Özdoğan 2011). The houses are divided into a small dwelling space and a cool, dry storage area with underfloor channels (Fig. 3; Hauptmann 2011, 90–94). Layer V, being the youngest, yielded structures similar to those known from subphase 5 at Çayönü (Hauptmann 2011, 94–95). Starting from layer II, a massive, almost square limestone building set on one side into a slope, was part of the settlement (Fig. 4; Hauptmann 1993; Hauptmann 2011, 95–98). T- or Γ-shaped stone pillars, likely serving as roof supports, alternate with benches along the inside walls; a pair of similar pillars were unearthed in the centre of the building (Fig. 5). Some of these pillars display arms at the lateral flanks that continue in hands resting on the front side, identifying them as highly stylised anthropomorphic depictions (Schmidt 2012, 73). In addition, they show two parallel raised vertical relief bands running along the borders of their front, which seem to be connected by two chevrons (V-shapes) below the head, identified as a stole-like garment. The ›special building‹ comprised at least three construction phases measuring 13.9 × 13.5 m in its earliest phase (Hauptmann 2011, 95–98). One wall had a niche interpreted by the excavator as the former location of a cult statue. This contributed to the identification of the building as a space dedicated to an ancestor cult.

In addition to the pillars, ten large limestone sculptures of humans and animals were discovered as *spoliae* in the eastern bank and wall (Hauptmann 2011, 98–100; see below Fig. 17). Interestingly, large stone sculptures are nearly all restricted to the ›special building‹, whereas the roughly 665 clay figurines known from the site were only found in the domestic areas (Morsch 2002; Morsch 2017). Roughly 90 % of these figurines represent humans. In about equal numbers,

3 Hauptmann 1993; Hauptmann 1999; Hauptmann 2011.

**Fig. 4** Nevalı Çori, the rectangular special ›building‹. Starting from layer II, a massive, almost square limestone building, set on one side into a slope, was part of the settlement in addition to the domestic architecture. The building is characterised by T- or Γ-shaped stone pillars alternating with benches along the inside walls and a pair of similar pillars in the centre of the building.

***Abb. 4*** *Nevalı Çori, das rechteckige ›Sondergebäude‹. Ab Schicht II gehörte neben der Wohnbebauung auch ein massives, fast quadratisches Kalksteingebäude zur Siedlung, das an einer Seite in einen Hang gesetzt war. Das Gebäude ist gekennzeichnet durch T- oder Γ-förmige Steinpfeiler, die sich mit Bänken entlang der Innenwände abwechseln, und durch ein Paar ähnlicher Pfeiler in der Mitte des Gebäudes.*

**Fig. 5** One of the central pillars from the ›special building‹ at Nevalı Çori. The pillar is decorated with arms on the broad sides and hands resting on the front side, where two V-shapes and raised vertical bands are also identifiable. In particular, the arms and hands motif hints at the anthropomorphic character of the pillar.

***Abb. 5*** *Einer der Zentralpfeiler aus dem ›Sondergebäude‹ in Nevalı Çori. Der Pfeiler ist an den Breitseiten mit Armen verziert; die Hände ruhen auf der Vorderseite, wo auch zwei V-artige Winkel und zwei erhabene vertikale Bänder zu erkennen sind. Vor allem das Motiv der Arme und Hände deutet auf den anthropomorphen Charakter des Pfeilers hin.*

naked seated females and standing males are depicted (cf. Fig. 1). The latter are sometimes wearing belts or sashes; incisions and dots likely refer to animal skins as material; genitals are indicated in some cases (Morsch 2017, 131). The particular and mutually exclusive spatial distribution of clay and stone imagery (including the pillars) contributed to the view that the building was the location for ritual performances, clearly separated from domestic activities and domestic cult, which could indicate that the differently depicted garments belonged to different spheres of social practices.

A similar pillar-architecture was discovered a short time later at Göbekli Tepe, extending over a much larger spatial scale, comprising several partly contemporary ›special buildings‹. Göbekli Tepe is located some 15 km to the north-east of the provincial capital Şanlıurfa in south-eastern Turkey on a dominant point of the Germuş mountain range (Schmidt 2012; Kurapkat 2015; Dietrich/Schmidt in press). The tell (Fig. 6) rises about 15 m above the surrounding limestone plateau, whose lateral outcrops once served as the quarries for the large blocks used in the site's megalithic structures. Fieldwork at Göbekli Tepe began in 1995 under the direction of K. Schmidt (Beile-Bohn et al. 1998). After an initial survey and following prospective soundings, work concentrated within the south-eastern depression of the site (Fig. 7). There, the first of the monumental circular buildings of the PPNA to Early PPNB was uncovered, for which the site is world famous today[4]. The buildings are formed of circularly arranged, often richly decorated T-shaped limestone pillars interconnected by walls with bench-like structures along the inner faces (Schmidt 2012; Dietrich/Schmidt in press). These pillars rise to 4 m in height and are arranged around two even larger central pillars; the buildings' inner diameter is roughly between 10–20 m. The buildings were roofed and likely subterranean (Kurapkat 2012). Seven such monumental enclosures have been discovered so far (Buildings A–D[5], E[6], F[7], H[8]). The preserved entranceway of Building C has a deliberately ›difficult‹ layout with up- and downward turns and visual blinds (Piesker 2014). Set into the walls inside, sculptures of leaping dangerous animals baring their teeth and tusks confronted the entering visitors,

**Fig. 6** Göbekli Tepe. View of the tell from the surrounding limestone plateau before protective shelters were erected above the site. The plateau served as the quarry area for the megalithic stone pillars and other building materials.

***Abb. 6*** *Göbekli Tepe. Blick auf den Tell vom umliegenden Kalksteinplateau aus, bevor die Schutzbauten über der Anlage errichtet wurden. Das Plateau diente als Steinbruchgebiet für die megalithischen Steinpfeiler und andere Baumaterialien.*

who ended up face to face with the imposing pair of pillars rising to 5.5 m in the centre. In flickering light, the visitors would have been able to partly discern the likewise intimidating animal bas-reliefs on the encircling pillars. Smaller rectangular or sub-rectangular buildings of about 3 x 4 m, sometimes with small T-shaped pillars that largely lack animal reliefs, are the characteristic features of a second, early to middle PPNB architectural horizon[9]. Direct stratigraphic evidence for this chronology, indicating that (some of) the rectangular buildings belong to a phase following the round structures, exists only in a few locations[10].

K. Schmidt interpreted Göbekli Tepe as a special site dedicated to cult and ritual, with only a few people or even no-one permanently living there (Schmidt 2005, 34). This interpretation was based on the impression that a stable water supply and substantial domestic buildings were missing next to the large pillar buildings. Meanwhile, however, evidence for domestic activity has accumulated. Already in 2011, deep soundings had revealed simple small stone rings of max. 2 m diameter next to the monumental buildings (Schmidt 2011, 47–48), a type of architecture well-known from Epipalaeolithic or PPNA settlements of the region (Özdoğan 2017). Also, the rectangular buildings turned out to be partly contemporary with the later construction phases of the monumental round buildings (Dietrich 2011). They produced clear evidence for domestic practices at the site, including the large-scale grinding of cereals (Dietrich 2021). However, the complex house types known from contemporary settlements in the near vicinity of Göbekli Tepe (see above; Özdoğan 2017)[11] and storage facilities are still absent; nevertheless, much does indeed hint at seasonal fluctuation in site use with a reduced permanent presence of people (Dietrich/Dietrich 2024). While diverse interpretations have been put forward over the last decades for the clear evidence for ritual performances in the monumental buildings (Dietrich/Notroff 2015), an interpretation along the lines of shaman-

4 Layer III after Schmidt 2011, 42–48. Layers at Göbekli Tepe have been defined through their characteristic architecture. Building horizon would be a better label, as ›layer III‹ and the younger ›layer II‹ are actually composed of several strata resulting from complex formation processes: Dietrich 2021, 5–9. Radiocarbon data: Dietrich et al. 2013. Layer I is the mixed and disturbed uppermost horizon.

5 Schmidt 2011, 44–47; Schmidt 2012; Piesker 2014; Kurapkat 2015; Dietrich/Schmidt in print.

6 Piesker 2014.

7 Dietrich/Wagner 2023.

8 Dietrich et al. 2016.

9 The so-called ›layer II‹: Schmidt 2012, 216–221; Kurapkat 2015, 18–22.

10 Schmidt 2000, 18–19; Schmidt 2012, 128, 228; Kurapkat 2015, 81–82.

11 The most complete succession of PPN building types still comes from Çayönü: Erim-Özdoğan 2011.

**Fig. 7** Göbekli Tepe. Overview of the south-eastern depression, where Buildings A–D were discovered. Building D in the foreground exemplifies the characteristic layout of these buildings: a circular wall is divided by up to 4 m high standing pillars and benches; two larger, up to 5.5 m high pillars stand in the centre.

***Abb. 7*** *Göbekli Tepe. Überblick über die südöstliche Senke, in der die Gebäude A-D entdeckt wurden. Das Gebäude D im Vordergrund ist ein Beispiel für den charakteristischen Grundriss dieser Bauten: Eine kreisförmige Mauer wird durch bis zu 4 m hohe Pfeiler und Bänke untergliedert; zwei größere, bis zu 5,5 m hohe Pfeiler stehen in der Mitte.*

ism embedded in an animistic ontology has recently gained momentum[12].

## Anthropomorphic pillars as images and image carriers

Nearly all pillars in the monumental and the younger buildings at Göbekli Tepe share the same basic form resembling the Latin letter ›T‹ when viewed from the side; the Γ-shape, which seems to relate to refurbishing of T-pillars, is rare (Fig. 8). K. Schmidt saw the Göbekli Tepe pillars as both images and image carriers (cf. Hauptmann/Schmidt 2007, 79–80; Schmidt 2012, 70–72). He perceived the T-shape as the stylised representation of the human body in profile, with the wider part at the top as the head and the shaft below representing the body. This view had been induced by the pillars discovered earlier during excavations at Nevalı Çori, which, as mentioned, had anthropomorphic traits and indications for depictions of clothing. At Göbekli Tepe, bas-relief depictions of arms and hands appear on nine pillars, 29 show the relief bands on the front side, and five the V-shapes in the neck area (Dietrich 2024, 14–17 Tab. 2). On the central pillars of Building D (Pillars 18 and 31; Fig. 9–10), these elements were found in combination with representations of belts and loincloths (Köksal-Schmidt/Schmidt 2010).

A comparison with other Early Neolithic anthropomorphic depictions strengthens the case for identify-

12 Benz/Bauer 2013; Borić 2013; Benz/Bauer 2015; Dietrich 2024.

**Fig. 8** Göbekli Tepe, Pillar 43. All pillars in the monumental buildings at Göbekli Tepe share the same basic form, resembling the Latin letter ›T‹ when viewed from the side. They are frequently decorated with animal reliefs. Pillar 43 in Building D is among the most richly ornamented pillars.

***Abb. 8*** *Göbekli Tepe, Pfeiler 43. Alle Pfeiler der älteren Monumentalbauten in Göbekli Tepe haben die gleiche Grundform, die von der Seite betrachtet dem lateinischen Buchstaben ›T‹ ähnelt. Sie sind häufig mit Tierreliefs verziert. Pfeiler 43 in Gebäude D gehört zu den am reichsten verzierten Pfeilern.*

**Fig. 9** Pillar 18, one of the central pillars of Building D at Göbekli Tepe. The pillar features arms, hands, a belt and a loincloth, as well as relief bands. It stands on a pedestal decorated with a row of birds, and has the relief of a fox on its right broad side.

***Abb. 9*** *Pfeiler 18, einer der beiden Zentralpfeiler von Gebäude D in Göbekli Tepe. Der Pfeiler zeigt Arme, Hände, einen Gürtel und einen Lendenschurz sowie Reliefbänder. Er steht in einem Sockel, der mit einer Reihe von Vögeln verziert ist, und trägt auf ihrer rechten Breitseite zusätzlich das Relief eines Fuchses.*

ing the T-shape as a reference to the human body (Fig. 11; Hauptmann/Schmidt 2007, 79–80; Kurapkat 2015, 99–101 Fig. 159). The best-preserved example of a life-sized anthropomorphic PPN sculpture is the so-called Urfa-Man (cf. Fig. 11,1), found during construction work in the Pre-Pottery Neolithic site Urfa-Yeni Mahalle/Yeni Yol, Şanlıurfa Province, Turkey (Çelik 2011), broken in four nearly equal pieces (Hauptmann 2003)[13]. The sculpture depicts a man standing frontally with arms depicted on the sides of the body and hands resting on the front in the pubic area above the phallus. Eyes (probably originally emphasised by obsidian inlays), nose, and ears are depicted; the mouth is absent. The figure seems to be naked, apart from a double V-shape on the upper body. The position of arms and hands is similar to their depiction on the T-shaped pillars. The chevron, i.e. the double V-shape, resembles the reliefs on the Nevalı Çori pillars and on some at Göbekli Tepe (e.g. Pillar 74 in Building F: Dietrich/Wagner 2023). The nakedness of the depiction argues against a connection of this feature with the assumed ›stole‹ (relief bands). Seen from the side, the Urfa-Man appears distinctly stele-like; the depth of the body is not anatomically correct, except for the head, prompting an association with the T-shape of the pillars. This association is even stronger regarding a second, more abstract image. The so-called Kilisik Statue (Fig. 11,2), about 80 cm tall, was acquired from a farmer in 1965 near the village of Kilisik (Hauptmann 2000). It has a long, curved T-bar-shaped head; along its body, bent arms similar to those observed on the pillars appear. At the front, the arms seem to hold the head of a second, smaller figure; below this figure is a deep perforation. Set beside these examples, the Nevalı Çori (Fig. 11,3) and Göbekli Tepe (Fig. 11,4) pillars seem like the endpoints

13 The find context remains unclear, as the site was destroyed mostly without archaeological observation. Images show a smaller T-shaped pillar, which may hint at a destroyed ›special building‹: Çelik 2011, 142 Fig. 19.

**Fig. 10** Pillar 31, the second central pillar of Building D at Göbekli Tepe. Like Pillar 18, it features complex depictions of clothing, including a belt and fox fur loincloth.

***Abb. 10*** *Pfeiler 31, der zweite Zentralpfeiler von Gebäude D in Göbekli Tepe. Wie Pfeiler 18 weist er komplexe Darstellungen von Kleidung auf, darunter einen Gürtel und einen Lendenschurz aus Fuchspelz.*

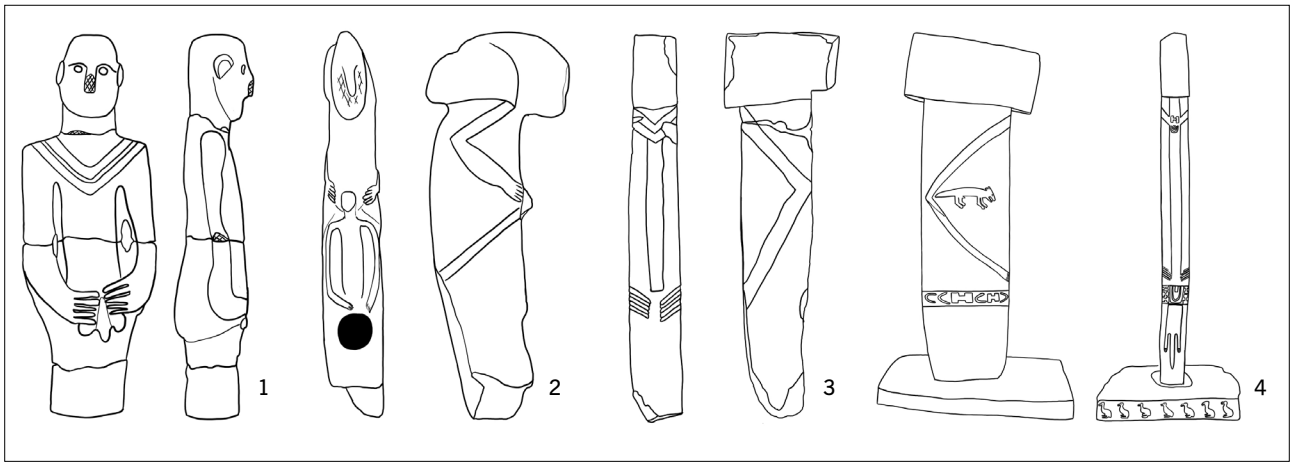


**Fig. 11** A comparison of PPN anthropomorphic depictions strengthens the identification of the T-shape as a reference to the human body and shows the steps towards stylization. 1 The so-called ›Urfa-Man‹; 2 The Kilisik sculpture; 3 pillar from Nevalı Çori; 4 Pillar 18 from Göbekli Tepe. Not to scale.

***Abb. 11*** *Ein Vergleich anthropomorpher Darstellungen des akeramischen Neolithikums sichert die Identifizierung der T-Form als stilisierte Darstellung des menschlichen Körpers weiter ab und klärt die Abstraktionsschritte. 1 Der sogenannte ›Urfa-Mann‹; 2 Die Kilisik-Skulptur; 3 Pfeiler aus Nevalı Çori; 4 Pfeiler 18 aus Göbekli Tepe. Nicht maßstabsgetreu.*

in a sequence of ever more abstracted images of the human body. This is not a chronological sequence, though, as the more naturalistic small to approximately life-sized anthropomorphic sculptures appear in parallel with the stylised T-shapes. Rather, it seems that the T-shape is the PPN cultural convention of rendering large anthropomorphic figures. In any case, K. Schmidt's view that the pillars were both anthropomorphic representations themselves and – at the same time – image carriers, is fully justified.

## Anthropomorphic pillars with zoomorphic decoration

To date, 72 pillars have been uncovered inside the monumental round Buildings A–D, F and H (Dietrich 2024; Dietrich/Schmidt in press). Fifty-one carry bas-reliefs or traces of erased reliefs; most represent animals, but some also display ›abstract signs‹ in the form of the Latin letters ›H‹ or ›C‹ (Morenz/Schmidt 2009). The variety of the images is wide but not random, and there are undisputable preferences for some motifs. Sorted by frequency, the number of pillars displaying certain images is as follows: relief bands (29), snake (19), bird (24), fox (14), wild boar (11), leopard (9), arms/hands (8), aurochs (7), H-shaped signs (7), bucranium (6), V-shape (5), arthropod (4), circle/disc (4), human (3 or 4), gazelle (2), chevron band (2), H- and C-shaped signs (2), clothing (2); some additional motifs occur only once (Dietrich 2024, 14–17 Tab. 2). The predominance of certain images in particular buildings was mentioned early on and has been confirmed as the iconographical canon of depictions has grown (Peters/Schmidt 2004, 208–209 Pl. 2; Becker et al. 2012, 33–37). Snakes are common in Building A, foxes in Building B, wild boar in Building C, and leopards in Building H. Snakes and foxes are also common in Building D, but birds occur in equal numbers. In contrast, Building F displays the highest number of anthropomorphic elements.

The imagery fails to reflect the locally hunted fauna in both its spectrum and frequency. The hunted game was predominantly gazelle, aurochs, and Asiatic wild ass (Peters/Schmidt 2004, 206–208; Pöllath et al. 2018, 32). The most frequently hunted animal, the gazelle, appears on two pillars only and the wild ass only once (Dietrich/Schmidt in press). There is a certain tendency to depict powerful animals like wild boar, leopards, aurochs, and bears, or the poisonous Levantine viper (Peters/Schmidt 2004, 183–184). On the other hand, foxes are skilled predators and, like leopards, are often depicted in leaping positions. The high frequency of bird depictions is also remarkable – for the PPN, the role of birds in beliefs surrounding death has been noted[14]. If the gender of animals is indicated, it is always expressively male. Almost all mammals are shown in attitudes of intense motion, often leaping (Busacca 2017). As for the animals on the lateral flanks of the pillars, their movement is almost consistently oriented towards the centre of the buildings. On the pillar fronts, they frequently occur in either upward or downward orientation (Busacca 2017, 326 Fig. 7). Snakes tend to transgress the limits between the image panels and are the only animals frequently shown moving downwards (Peters/Schmidt 2004, 184). The general sense of movement towards the centre of the buildings evokes a congregation, actively focusing on and emphasising the two central pillars. K. Schmidt aptly called this an ›animal gathering‹ (Schmidt 2012, 118). In any case, the deliberate choice of certain animal species that do not reflect the hunted spectrum but share certain characteristics (power, prowess, danger) is remarkable. As will be shown below, their placement on the pillars is key to a deeper understanding of the site.

## Vested anthropomorphic pillars

The belts and loincloths on two pillars not only prove their anthropomorphic character but further show that the depicted individuals, at least in some cases, were meant to be shown as wearing vestments. As Göbekli Tepe´s imagery is characterised by a high degree of stylisation, sometimes bordering on abstraction, further hints for clothing must be addressed. The starting point for a deeper discussion of garments on the pillars is the two parallel relief bands running down the frontal faces of many pillars. K. Schmidt interpreted these as stoles. Notwithstanding their interpretation, these depictions remained, to some degree, enigmatic. At one stage, L. D. Morenz and K. Schmidt (2009, 17) also suggested that the bands might symbolise the chest. Here, a third interpretation is favoured, which arises from a close inspection of the two most elaborately vested examples, Pillars 18 and 31. The present argument starts from the lower area of the pillars, where the hands and the belts/loincloths are depicted. On Pillar 18 (cf. Fig. 8; Fig. 12,1), the hands rest on the relief bands. The relief bands are worked lower in this area, giving the impression of disappearing below or ending at the belt. The belt, on the other hand, is shown again by slightly depressing the relief, as if lying above the fox pelt loincloth and securing it. The upper part of the fox pelt is turned down and superposes the belt. While the two relief bands are not continued below the pelt on Pillar 18, they are, however, on Pillar 31, which otherwise is similarly designed (cf. Fig. 12,2). Apparently, on Pillars 18 and 31, layers of clothing are depicted. In fact, it seems possible that the pillars are shown to wear long, open gowns, and the parallel bands represent the hems of these gowns. Whether these gowns have long sleeves remains unclear: a scratched line in the hand area could mean this or might be intended to delineate the hand (Fig. 13).

As the bands do not continue below the belt at Pillar 18, two kinds of gown differing in length could be meant (Fig. 14). Of course, this detail could have been omitted for another reason, e.g. the pillar could be unfinished. A hint in that direction is the belt, which – on the left lateral flank – remains empty in its rear part. Few other pillars are complete (respectively completely excavated) in their lower parts to serve as a comparison here. However, several pillars exist with relief bands along their complete length (Fig. 15). Pillar 33 in Building D is the only one with decorations all over the

14 Lichter 2007 with references.

**Fig. 12** A comparison of the details of the relief bands and belts of Pillars 18 (a) and 31 (b) reveals that layers of clothing are depicted.

***Abb. 12*** *Ein Vergleich der Details der Reliefbänder und Gürtel der Pfeiler 18 (a) und 31 (b) zeigt, dass Kleidungsschichten dargestellt sind.*

**Fig. 13** Göbekli Tepe, detail of arms and hands above the belt on Pillar 18. A scratched line in the hand area could mean the end of a long sleeve or delineate the hand.

***Abb. 13*** *Göbekli Tepe, Detail von Armen und Händen oberhalb des Gürtels an Pfeiler 18. Eine eingeritzte Linie im Handbereich könnte das Ende eines langen Ärmels andeuten oder die Hand abgrenzen.*

relief bands (Fig. 16; 18,2). Interestingly, the decorations in the lower parts actually represent the heads of snakes whose bodies are located on the pillar´s broad sides. No part of the decoration transgresses the borders of the relief bands, strengthening the case for a cloak. In the case of Pillar 33, the area between the bands is also decorated, hinting at another layer of clothes. The consequence of the interpretation of clothed pillars would be that many of the reliefs actually are located on the gowns, referring to possibly embroidered or stamped ornaments on Early Neolithic garments.

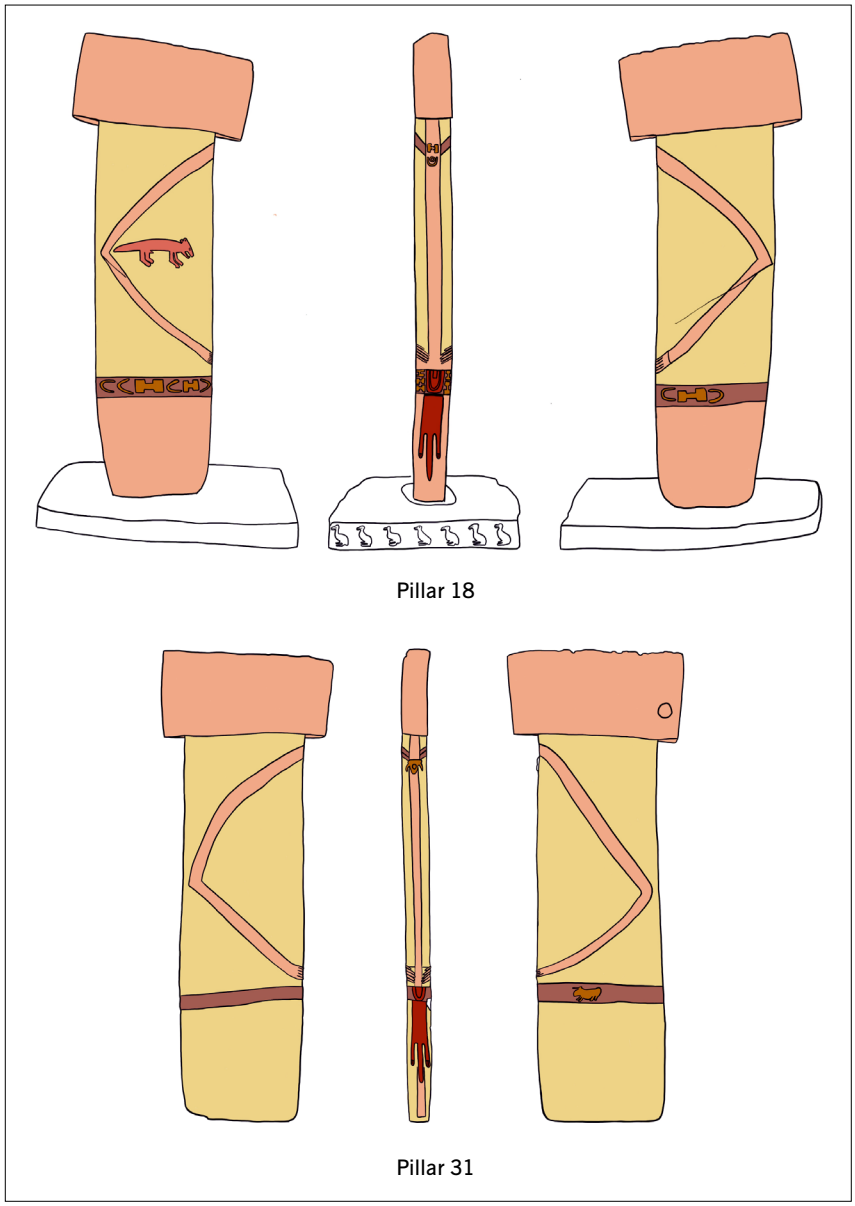


**Fig. 14** Göbekli Tepe. Garments shown on pillars 18 and 31. The relief bands on the front sides of the pillars can be interpreted as the hems of long gowns; the animal reliefs would then be decorations on these garments.

***Abb. 14*** *Göbekli Tepe. Kleidungsstücke auf den Pfeilern 18 und 31. Die Reliefbänder an den Vorderseiten der Pfeiler können als Säume von langen Gewändern interpretiert werden; die Tierreliefs wären dann Verzierungen auf diesen Gewändern.*

Depictions located on the broad side of the heads would then either have to be interpreted as body paintings, tattoos, or as being located on the hoods of the individuals' clothes, which would explain the omission of ears, hair and facial features. In any case, we are confronted with garments likely to serve a special purpose, closely related to that of the monumental buildings.

## Special garments at the dawn of a new way of life

The author has recently proposed that the imagery and ›special buildings‹ of Göbekli Tepe and contemporary sites can be seen in the context of an animistic ontology in the sense of P. Descola (2013) with shamans as ritual specialists. This argument is based on finds, architectural details and iconography (Dietrich 2024). As such, brief remarks with an emphasis on clothing may suffice here. In many hunter-gatherer societies, shamans play a key role in negotiating social life and crisis situations. Shamans contact the spirit world during an altered state of consciousness (Lewis-Williams 1988; Lewis-Williams/Dowson 1993; van Pool 2009, 178) and their soul or alter ego travels to the otherworld guided and guarded by helper spirits, often in zoomorphic form, to assist their community. The layout of Göbekli Tepe´s ›special buildings‹, with the emphasis on a congregation of animals centred on the two large pillar-beings placed roughly in the middle of the buildings, could well mirror a cosmology. Sculptures that likely depict individuals in a trance accompanied by animals (Dietrich 2024, 39 Fig. 13) or imagery that refers to the shamanic voyage (Dietrich 2024, 38–40) strengthen this interpretation. The characteristic fields of shamanic activity are healer, diviner, psychopomp, bringer of luck/misfortune, overseer of sacrifices (Bäckman/Hultkrantz 1978, 14–17), and keeper of a group´s myths/traditions through creation, memorisation, and performance of songs and poetry (Lommel 1980, 18; Hoppál 1994, 16, 22). The rich iconography on many pillars, which has been interpreted as referring to mythical stories (e.g. Borić 2013; Schmidt 2013), may illustrate the latter

**Fig. 15** Pillars 37 (foreground) and 27 in Building C during excavations in 2009. Both have relief bands along their entire front sides. Pillar 37 is the building's western central pillar and was destroyed in prehistory. Pillar 27 is the only one so far known at Göbekli Tepe with a preserved high relief on its front side. It depicts a leopard lurking in front of a boar in low relief.

***Abb. 15*** *Die Pfeiler 37 (Vordergrund) und 27 in Gebäude C während der Ausgrabungen im Jahr 2009. Beide tragen Reliefbänder entlang ihrer gesamten Vorderseiten. Pfeiler 37 ist der westliche Zentralpfeiler des Gebäudes und wurde bereits in vorgeschichtlicher Zeit zerstört. Pfeiler 27 ist der einzige bisher bekannte Pfeiler in Göbekli Tepe mit einem erhaltenen Hochrelief. Das Hochrelief zeigt einen Leoparden, der vor einem in Flachrelief dargestellten Wildschwein lauert.*

**Fig. 16** Pillar 33 in Building D at Göbekli Tepe. Most reliefs are located on the right broad side and the front side; the left broad side has fewer images. Unlike most other pillars, the reliefs partly cross the boundaries between these areas. In the lower part of each broad side (Fig. 18b) is a group of snakes whose heads lie on the front side. No part of the decoration transgresses the borders of the relief bands, strengthening the case for a cloak.

***Abb. 16*** *Pfeiler 33 in Gebäude D in Göbekli Tepe. Die meisten Reliefs befinden sich auf der rechten Breitseite und der Vorderseite des Pfeilers; auf der linken Breitseite gibt es weniger Darstellungen. Im Gegensatz zu den meisten anderen Pfeilern überschreiten die Reliefs teilweise die Grenzen zwischen diesen Bereichen. Im unteren Teil jeder Breitseite (Abb. 18b) befindet sich eine Gruppe von Schlangen, deren Köpfe auf der Vorderseite liegen. Kein Teil dieser Verzierung überschreitet jedoch die Grenzen der Reliefbänder, was für einen Mantel spricht.*

aspects. Elaborate garments richly decorated with animal imagery would certainly fit this line of interpretation, as the costume features prominently among the shamanic sacra.

The equipment of Eurasian shamans frequently includes a specific costume (cloak, shirt, trousers, belt, headdress, mittens, shoes) that differs regionally and in elaboration[15] but usually has references to or images of helper spirits, often in the form of zoomorphic pendants/applications, embroidery, or textile strands. The sum of the pendants or embroidered zoomorphic and anthropomorphic images on the costume often represents the assembly of an individual shaman´s helper spirits. The whole coat can be meant to symbolise an animal (Shirokogorow 1935, 67; Prokofjeva 1963, 129). Evenki shaman costumes, for example, can feature fabric bird wings (Hoppál 1994, 30–31 Fig. 19). In Enets costumes, the bird imagery is reduced to fringes on hems and sleeves, meaning feathers, and three wedge-shaped projections on the back, suggesting the bird´s tail (Prokofjeva 1963, 128 Fig. 2–3). Tuva coats often display bundles of ribbons on the back, symbolising snakes as important helper spirits; rows of pendants are meant to symbolise birdwings (Djakonova 1978, 333–334; 337–338 Fig. 2).

In the Polar North, belts richly decorated with miniaturised objects, animal teeth, bones, skin, figurines, textile strands, and full-sized weapons or tools received from their community were both shamanic paraphernalia and impor-

15 Holmberg 1922; Nioradze 1925, 66–74; Shirokogorow 1935, 67–69 Fig. 2–4; Prokofjeva 1963; Djakonova 1978; Gračeva 1978; Hoppál 1994, 108–114; Pavlinskaya 1994; DuBois 2009, 177; Anawalt 2014; Reymann 2015, 92–99.

**Fig. 17** Nevalı Çori, the so-called bird man (ht. 23 cm) from the ›special building‹. Seen from the side, one has the impression of a bird with a large beak and wings hanging vertically at the sides of the body. However, the frontal view reveals a human face inside the beak, and a ridge running along the forehead changes the impression, suggesting a human wearing a hooded cloak.

***Abb. 17*** *Nevalı Çori, der sogenannte Vogelmann (H. 23 cm) aus dem ›Sondergebäude‹. Von der Seite betrachtet hat man den Eindruck eines Vogels mit einem großen Schnabel und senkrecht an den Seiten des Körpers hängenden Flügeln. In der Frontalansicht erkennt man jedoch ein menschliches Gesicht innerhalb des Schnabels, und ein entlang der Stirn verlaufender Grat lässt auf einen Menschen schließen, der einen Kapuzenmantel trägt.*

tant signs of the profession (Laugrand 2010, Fig. 34; Ryan/Young 2013, 28–29). Belts with chimes, rattles and various small objects also feature in costumes of other shamanic traditions (Hoppál 1994, 114–115 Fig. 140–141). Headdresses may vary from a simple band over caps with zoomorphic elements (Prokofjeva 1963, 140–141 Fig. 19; Hoppál 1994, 121 Fig. 156–157) to complex shaman ›crowns‹ that frequently feature antlers, feathers, or metal applications (Nioradze 1925, 74–76; Hoppál 1994, 29, 76 Fig. 84–85; 116–121 Fig 144–155; Hamayon 2021). Headdresses often include a veil-like element meant to hide the shaman's face from malevolent spirits (Reymann 2015, 85, Fig. 27, 99–101), made of cloth or strings with dangling animal teeth (Hoppál 1994, 52–53 Fig. 51–52; 62–63 Fig. 63; 76 Fig. 84; 90 Fig. 105; 117 Fig. 147–148). Like the veil, masks[16], which often have no (Prokofjeva 1963, 140 Fig. 20–22) or only small eye openings (DuBois 2009, 179), can be used to hide the shaman's face during contact with the spiritual world (Shuyun 2003, 167–168). Masks are seen as protection from supernatural attacks, much like the costume in general (Shuyun 2003, 169–170). However, their functions are broader: masks are tools that facilitate contact with spirits; by cutting off contact with the real world, they force the shaman to focus his gaze inwards (Shuyun 2003, 166–167).

The shaman costume is seen as an animate object with several functions: a) representation of a special position of the wearer; b) symbolic or actual depiction of the helper spirits; c) protection from supernatural attacks; d) representation of cosmology; e) seat of part of the vital energy or supernatural power of a shaman[17]. In some cultures' belief systems, the spirits will not recognise the shaman without the specific costume – lacking it, he or she would be helpless in the otherworld (Kortt 1991, 28). As the costume represents a specific assembly of spirits, in some cultures, shamans possess multiple costumes for different occasions (Gračeva 1978, 315–316; Hoppál 1994, 29; DuBois 2009, 177; 179).

While the site has delivered a variety of finds that may be identified as shamanic sacra (Dietrich 2024, 43–48), the imagery discovered at Göbekli Tepe and contemporary sites hints at the shaman costume beyond the animals depicted on the clothes worn by the T-shaped pillar-statues. First, there is ample evidence for masks and masking. Several stone-sculptured depictions of masks are known from Göbekli Tepe and other sites like Jerf el-Ahmar and Nevalı Çori (Dietrich et al. 2018a; Dietrich et al. 2018b). However, they depict only human faces without allusions to animals. Regarding other imagery, topics that hint at human-animal transitions or masking as animals are frequent motifs. The so-called birdman, a limestone sculpture from Nevalı Çori (Fig. 17), is a good example (Hauptmann 2011, Fig. 13a–b). Seen from the side, the impression is of a bird with a large beak and wings hanging vertically at the sides of the body. But the frontal view reveals a human face inside the beak, and a ridge running along the forehead changes the impression, suggesting a masked human wearing a hooded cloak. Given the static features of the upward-looking face with rounded opened mouth, and its similarity to a miniature mask from the same site (Dietrich et al. 2018b, 5 Fig. 2.), the depicted person is very likely wearing a mask. The sculpture points to the crossing of fluid borders between humans and animals, a topic that recurs in many PPN images (Dietrich 2024). It also provides an argument for the long gowns and hoods identified as a possible feature of the T-pillars.

16 Nioradze 1925, 77; Gračeva 1989; Hoppál 1994, 88 Fig. 102; 122–123 Fig. 158–161; Ivanov/Stukalov 1975; Shuyun 2003; DuBois 2009, 182–184.

17 List after Reymann 2015, 97, with bibliography.

**Fig. 18a–b** Göbekli Tepe, crane imagery on Pillar 2 (a) and Pillar 33 (b). While images of other birds are anatomically correct, crane images at Göbekli Tepe frequently have human legs. It is likely that those images depict masked humans.

***Abb. 18a–b*** *Göbekli Tepe, Kranichabbildungen auf Pfeiler 2 (a) und Pfeiler 33 (b). Während Bilder von anderen Vögeln anatomisch korrekt sind, haben Kranichbilder am Göbekli Tepe häufig menschliche Beine. Es ist wahrscheinlich, dass diese Bilder maskierte Menschen darstellen.*

Among the pillar reliefs, depictions of cranes provide important evidence. At an early stage, it had already been noticed that while images of other birds were anatomically correct[18], some of the crane images at Göbekli Tepe displayed human legs (Fig. 18), Hence, it may be that those images depict masked humans. This fits well with observations made by M. Benz and J. Bauer (2015, 3–4 Fig. 2–4) on the depictions of human figures on stone vessels from Körtik Tepe (Özkaya/Coşkun 2011, Fig. 4; Özkaya et al. 2013, 32) and Hasankeyf Höyük, Batman Province, Turkey (Miyake 2013, 45 Fig. 1), which the authors convincingly interpret as shamans. The images feature long striped gowns, headgear indicated by two long stripes possibly representing feathers, outstretched arms, leg positions implying movement, and in some cases, a beak-like mouth. Sometimes the individuals are associated with animals, but are always the only human-shaped beings in the images. A closer look reveals an interesting detail: on their remarkably narrow, rectangular front sides, the depictions on two vessels from Körtik Tepe clearly feature two parallel bands (Özkaya/Coşkun 2011, Fig. 4; Özkaya et al. 2013, 32). The shamans are wearing the gowns depicted on the Göbekli Tepe pillars.

## Conclusion

This brief overview of findings from Göbekli Tepe and contemporary sites is intended to highlight two key findings. First, the earliest life-sized to monumental stone sculptures made by humankind – highly stylised depictions as well as more naturalistic images – offer hints at clothing for a period that so far has produced few primary sources in the form of preserved textiles/fabrics. The items of clothing identified encompass simple headgear, belts, and loincloths, as well as long, probably hooded gowns abundantly decorated with animal figures. Second, the latter element of clothing, in particular, most likely does not represent a garment worn by all group members. Stylised anthropomorphic pillars with their animal symbolism are restricted to ›special buildings‹, just like the stone sculptures with similar elements of clothing, while Nevalı Çori shows that clay figurines from domestic areas have different features. According to their context and style, the long gowns worn by the pillar-statues, as well as the complex belts with fox fur loincloths, can be identified as clothing worn in ritual settings, most likely by shamans.

18 Peters et al. 2014, 176 with references.

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# Wrapping the Stone Age body: Clothing Jōmon *dogū* ceramic figures from the prehistoric Japanese archipelago

Simon Kaner

**Zusammenfassung**

Die Verhüllung des steinzeitlichen Körpers: Die Bekleidung von Jōmon *Dogū*-Tonstatuetten aus dem prähistorischen Japan

*Dieser Beitrag gibt einen Überblick über einige Funde von Kleidung aus der Jōmon-Zeit (ca. 12 500–500 v. Chr.) der japanischen Vorgeschichte. Die in dieser Zeit hergestellten* Dogū-*Tonstauetten zeigen Darstellungen von aufwendiger Kleidung, während an einer Reihe von Feuchtbodenfundstellen Reste von Pflanzenfasern erhalten blieben, von denen einige zu Stoffen gewebt waren. Die Menschen der Jōmon-Zeit schmückten ihren Körper wahrscheinlich auch mit kunstvollen Frisuren, Tätowierungen, Zahnfeilungen und Zahnentfernung sowie mit persönlichen Accessoires wie Halsketten und Perlen. Lackobjekte und Korbwaren zeugen ebenfalls von der Verwendung pflanzlicher Materialien. Die umfassenden Studien von Ozeki Kiyoko zu erhaltenen Jōmon-Stoffen werden erstmals in englischer Sprache vorgestellt. Es werden detaillierte Beschreibungen der Kleidung gegeben, die auf den Körpern von fünf* Dogū *zu erkennen ist, die kürzlich als Nationalschätze ausgewiesen wurden, die höchste kulturelle Auszeichnung in Japan, (Chobonaino, Kazahari I, Nakappara, Nishinomae und Tanabatake). Die große Anzahl außergewöhnlich gut erhaltener Körbe aus Higashimyō wird vorgestellt, ebenso wie die exquisiten Lackwaren aus Karinba. Der Artikel schließt mit einer kurzen Betrachtung darüber, wie Jōmon-Kleidung heute dargestellt wird und in Diskurse über das kulturelle Erbe eingeflossen ist, beispielsweise in die Aufnahme von 17 Jōmon-Fundstätten in Nordjapan in die UNESCO-Welterbeliste. Es wird argumentiert, dass Kleidung in den Jōmon-Gesellschaften der Steinzeit eine wichtige Rolle bei der Darstellung und Schaffung von Identitäten spielte.*

**Schlagwörter** *Dogū*, Jōmon, Lack, Korbflechterei, Darstellung

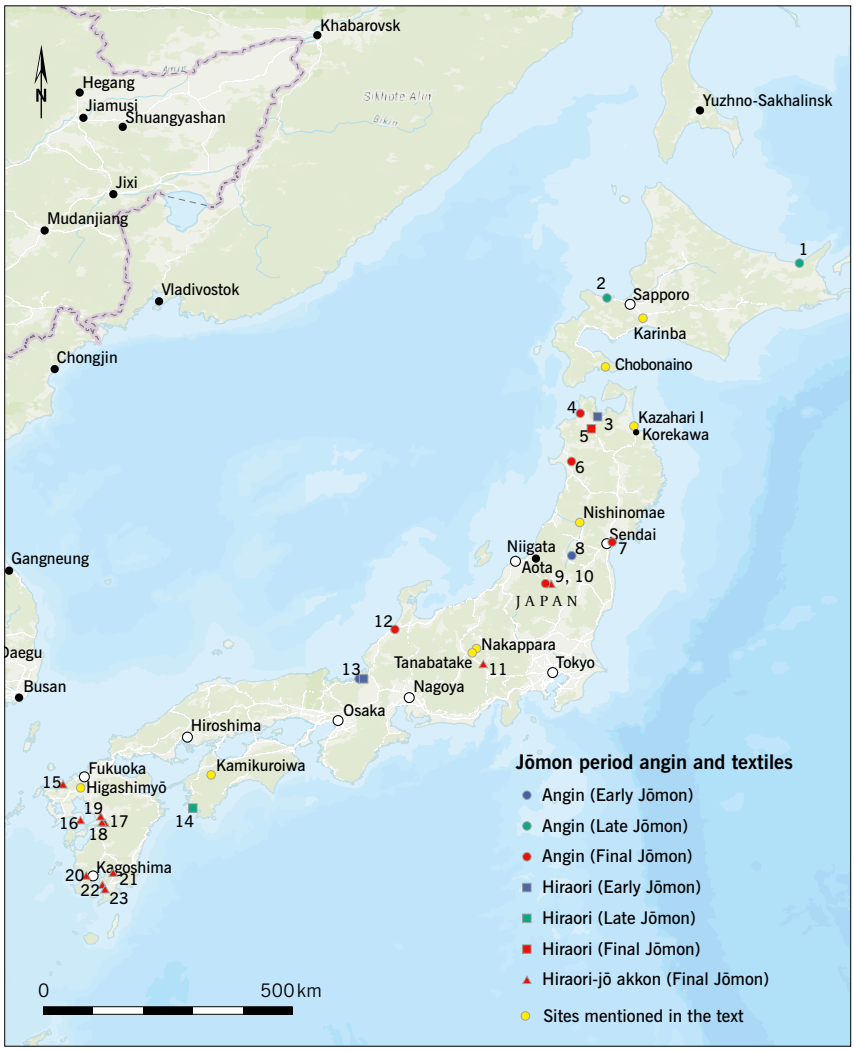
**Summary**

*This paper reviews some of the evidence for clothing from the Jōmon period (c. 12 500–500 BC) of Japanese prehistory. The* dogū *ceramic figures produced during this period bear representations of sophisticated clothing, while a number of waterlogged sites preserved remnants of plant fibres, some of which were woven into cloth. Jōmon peoples also likely ornamented their bodies with elaborate coiffures, tattoos, tooth filing and ablation, as well as personal accessories including necklaces and beads. Lacquer and basketry also attest to the use of plant materials. The comprehensive studies of surviving Jōmon threads by Ozeki Kiyoko are introduced for the first time in English. Detailed descriptions are provided of the clothing represented on the bodies of five dogū recently designated as National Treasures, the highest cultural designation in Japan (Chobonaino, Kazahari I, Nakappara, Nishinomae and Tanabatake). The large numbers of exceptionally well-preserved baskets from Higashimyō are introduced, along with the exquisite lacquerware from Karinba. The paper closes with a brief consideration of the ways in which Jōmon clothing is depicted today and has been incorporated into heritage discourses such as the UNESCO World Heritage inscription of 17 Jōmon sites in northern Japan. It is argued that clothing played an important role in the display and creation of identities in the Stone Age Jōmon societies.*

**Keywords** *Dogū*, Jōmon, lacquer, basketry, display

## Introduction

Display is an important behaviour for fully modern human beings (Wilson 1988). Human bodies and the ways in which they were wrapped and presented, both during their lives and after death, offered many opportunities for such display. This was the case in the prehistoric Japanese archipelago, just as it was elsewhere. Although the recently published Cambridge Global History of Fashion (Breward et al. 2023) does not deal with prehistory, the theme of the introductory chapter on ›the history of fashion without origins‹ (Chen 2023) makes the point that people throughout history have made statements through the fashions that they chose to wear. In this regard, the diversity of clothing on display in Japanese prehistory suggests that clothing, along with other forms of bodily ornamentation and material culture, was an important way for people to signal their identity, consciously deciding how to dress being a clear expression of agency.




*1 Shuen: Hokkaido, Final Late Jōmon; 2 Oshorodoba: Hokkaido, Late Jōmon; 3 Sannai-maruyama: Aomori, Early-Middle Jōmon; 4 Kameoka: Aomori, Final Jōmon; 5 Ishigō: Aomori, Final Jōmon; 6 Nakayama: Akita, Early Final Jōmon; 7 Sannō: Miyagi, Middle Final Jōmon; 8 Ondashi: Yamagata, Early Jōmon; 9 Arayashiki: Fukushima, Final Jōmon; 10 Arayashiki: Fukushima, Latest Final Jōmon-Beginning of Yayoi; 11 Ubagami: Yamanashi, Final Jōmon; 12 Yonaizumi: Ishikawa, Final Jōmon; 13 Torihama: Fukui, Early Jōmon; 14 Hirajō: Chiba, Late Jōmon; 15 Nabatake: Saga, Middle Final Jōmon; 16 Yamanotera: Kumamoto, Final Jōmon; 17 Asōbaru: Kumamoto, Final Jōmon; 18 Uenohara: Kumamoto, Final Jōmon; 19 Shinyashiki: Kumamoto, Final Jōmon-Early Yayoi; 20 Fukikami: Kagoshima, Final Jōmon; 21 Kaminakadan: Kagoshima, Final Jōmon; 22 Miyashita: Kagoshima, Final Jōmon; 23 Enokibaru: Kagoshima, Final Jōmon.*

**Fig. 1** Map showing finds of Jōmon textiles, with other key sites shown.

***Abb. 1*** *Karte mit Fundorten von Jōmon-Textilien und anderen wichtigen Fundstätten.*

In this paper, I present an overview of some of the most significant recent evidence for clothing from the Jōmon period of Japanese prehistory. I discuss the evidence for such clothing from stone and clay representations based on the shape of the human body, before briefly considering the relationship between weaving textiles and basketry, the intensification of display in the later Jōmon period, and the ways in which evidence for clothing has become important in the current heritigisation of Jōmon archaeology.

The post-Pleistocene period in Japan is termed Jōmon, roughly dating to the period c. 12 500–c. 500 BC (which in many aspects is regarded as equivalent to the final Palaeolithic, Mesolithic and Neolithic elsewhere). Jōmon is a translation of ›cord-marked‹, the term used by Edward Sylvester Morse to describe the distinctive form of decoration he identified on pottery sherds he excavated from the Ōmori shell mounds on Tokyo Bay in 1877, widely accepted as the first archaeological investigation in Japan, resulting in a formally published report in Japanese and English (Morse 1879). These cord marks were created using twisted plant fibres. A great variety of ways of twisting and knotting these fibres came to be used during the Jōmon period (cf. Hurley 1979), many of which were identified by the pioneering archaeologist Yamanouchi Sugao, who used this diversity to create a chronological and regional framework for the period (cf. Kobayashi 2005; Taniguchi in prep.).

The weaving of these plant fibres into basketry and matting is evidenced by impressions on the bases of earthenware vessels, which had stood on such materials as they dried out prior to being fired in open bonfires. Such impressions were already noted by Morse in his report of his work at Ōmori (Morse 1879, 9). Although the predominantly acid-rich soils of the Japanese archipelago do not normally favour the survival of organic materials, there are certain exceptional circumstances, often relating to waterlogging and burning, when such materials do survive. An important factor in this can be the use of lacquer, the resin from the lacquer tree (*Rhus* sp.), native to many parts of Japan, which is used to create waterproof and shiny surfaces, often mixed with pigments to present an impressive and colourful effect (Matsumoto et al. 2022). From the Palaeolithic period onwards, stone tools such as scrapers were present, indicating the processing of animal skins and sinews to provide the materials needed for clothing necessary to survive in the cold conditions of the Ice Age. In the succeeding Jōmon period, with warmer conditions, people worked animal bones into pins and needles, which were important in the weaving together of plant fibres as cloth.

Some of the earliest indications for the use of clothing in the Japanese archipelago are the thin engraved lines etched into the surface of a series of small greenstone plaques from the Kami-kuroiwa rock shelter on the island of Shikoku (Aikens/Higuchi 1982, 107). These lines are interpreted by Japanese specialists such as Harunari Hideji as representing grass skirts, with other markings thought to be hair and breasts. Pottery sherds from the same layer as the engraved stones are dated to around 14 500 years ago, according to calibrated radiocarbon dates. Around the same date, tiny ceramic figures, *dogū* in Japanese, began to be made, apparently inspired by the shape of the human body, but in a very abstracted way. The *dogū* from Kami-ijiri in Mie prefecture is only 3 cm high and has no limbs or face. These objects, however, mark the start of what was to become one of the most remarkable traditions of sculptural representation from the prehistoric world, and *dogū* have become iconic emblems of the Jōmon period in the Japanese archipelago. Five of these *dogū* are now National Treasures, the highest level of cultural designation in Japan.

In addition to clothing, these figures also often exhibit elaborate body ornamentation including coiffures, ear ornaments, necklaces made up of strung beads and suggestions of tattoos. Many of the *dogū* figures are masked, and a number of stand-alone clay masks have also been discovered, indicating the materialisation of the concept of transformation through donning such accoutrements.

Alongside the *dogū* are a series of tantalising discoveries of woven fabrics made of plant fibres, sometimes subsequently treated with lacquer, which are described as personal accessories, including beads and pendants, armlets, ear ornaments and combs and hairpins.

Ozeki Kiyoko (2012; 2020) has made a comprehensive study of these fabric fragments, identifying over 20 sites where they have been found, from the northernmost coast of Hokkaido to the southern tip of Kyushu (Fig. 1). At Oshoro Doba near the city of Otaru in Hokkaido, 8–10 black and brown woven lacquered threads wrapped around a cobble some 30–40 cm in diameter were discovered. At Sannai

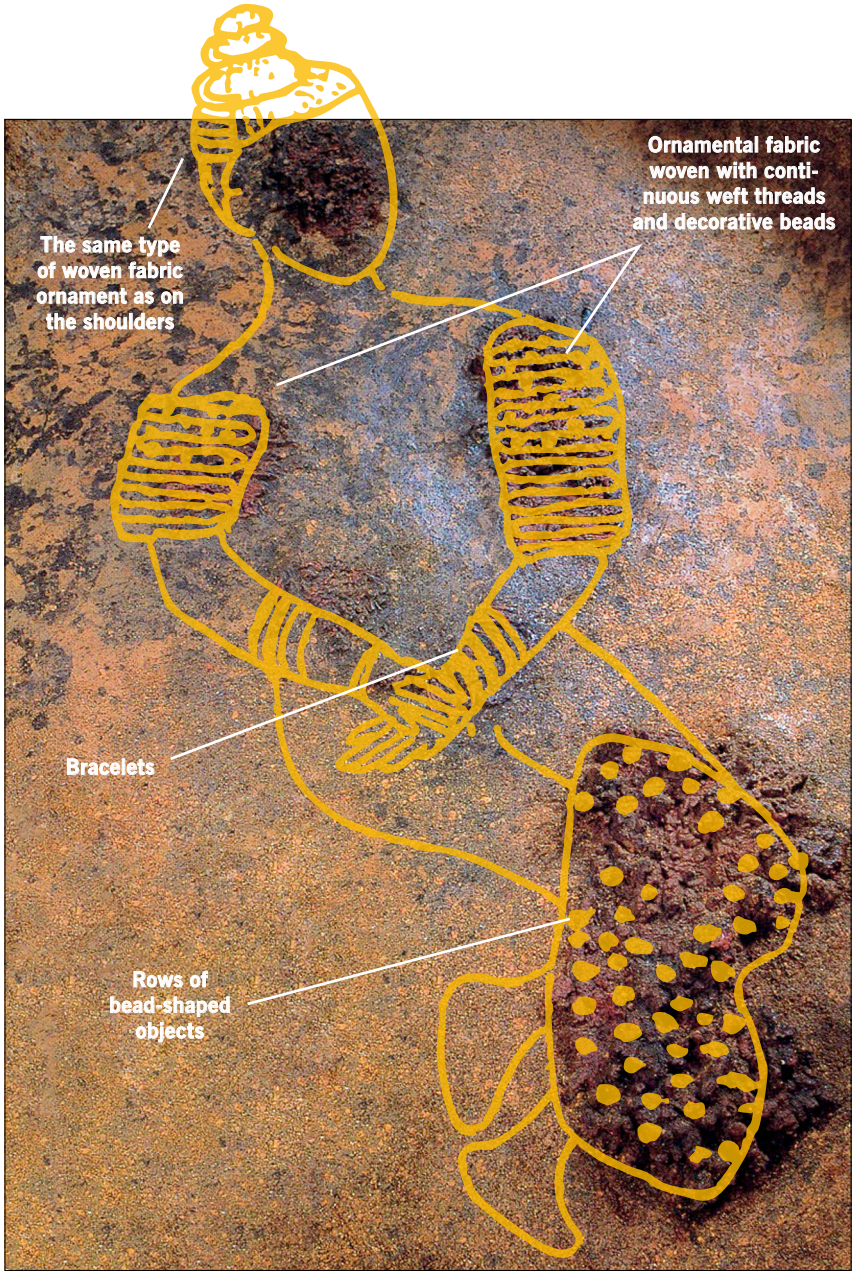

Ornamental fabric woven with continuous weft threads and decorative beads
The same type of woven fabric ornament as on the shoulders
Bracelets
Rows of bead-shaped objects

**Fig. 2** Lacquered funerary woven blanket from Kakinoshima B, Hokkaido, c. 9000 years old.

***Abb. 2*** *Lackiertes gewebtes Leichentuch aus Kakinoshima B, Hokkaido, ca. 9000 Jahre alt.*

**Fig. 3a–e** National Treasure dogū from Japan. a Nakappara (H. 34.0 cm); b Chobonaino (H. 41.5 cm); c Nishinomae (H. 45.0 cm); d Kazahari (H. 19.8 cm); e Tanabatake (H. 27.0 cm).

***Abb. 3a–e*** *Als Nationalschatz eingestufte Dogū aus Japan. a Nakappara (H. 34,0 cm); b Chobonaino (H. 41,5 cm); c Nishinomae (H. 45,0 cm); d Kazahari (H. 19,8 cm); e Tanabatake (H. 27,0 cm).*

Maruyama, fragments of textile were recovered that were »made of ramie (Chinese grass), bast fibres of a plant of the nettle family Urticaceae *(Boehmeria nivea var. nipononivea)* braided from woven yarn with warp and weft threads. The original yarns were less than a millimetre thick« (Okada 2021a, 310).

Lacquer trees were present in Japan from the end of the Pleistocene, as seen in the discovery of the oldest dated such tree from the Torihama shell midden on the Sea of Japan coast of central Honshu, dating to 12 600 years ago. The earliest dated lacquer itself comes from a blanket wrapping a body at Kakinoshima B in southern Hokkaido that was dated to around 9000 years ago, making it the oldest known lacquer from anywhere (Fig. 2). Sadly, the blanket was destroyed in a fire, and some sources now question the accuracy of the date (Matsumoto et al. 2022).

## Jōmon clothing as modelled by *dogū* ceramic figures

The five National Treasure *dogū* give a good impression of the range of potential types of clothing worn by Jōmon people (see Fig. 3; Kaner 2009), although others are depicted largely unclothed, notably the so-called ›Venus‹ of Tanabatake (Fig. 3e). Tanabatake is a large Middle Jōmon settlement site (4500–3500 years ago) with over 300 pit dwellings arranged in two distinct clusters, many containing caches of obsidian from sources high in the nearby mountains. The Tanabatake *dogū* figure was found in a pit at the centre of the southern settlement, and may have been some kind of foundation deposit, placed there by the community at the outset of the occupation. The *dogū* was found at the southwestern corner of the pit, its masked face pointing outwards. The size of the pit suggests that if it had originally contained a burial, then the bones were most likely interred long after death, once they were already disarticulated, and possibly stripped of their flesh. Such secondary burial is not uncommon in Jōmon contexts. Modelled from several large chunks of solid clay, and its surface glittering with deliberately introduced mica, the figure has no clothes, although the incised design around the pubic area could indicate an apron of some kind. The figure wears a ›heart‹-shaped mask, with narrow diagonal eye slits and an open mouth. The head is surmounted by an impressive headpiece with asymmetrical incised decoration on all sides and flat top, and it has two pierced ears. One foot is very slightly raised, effectively creating a sense of movement. The arms are abbreviated, and black patches across the body provide hints as to the parts exposed to the open fire during firing (Doi 2009a, 92). Archaeologist Tomii Makoto has made a study of these flame marks on other Jōmon pots, suggesting that there was an intended sense of directionality during the firing process (Tomii 2015).

A short distance from Tanabatake is the site of Nakappara, dating to several hundred years later than the Tanabatake site, where a large hollow masked *dogū* was discovered

in a pit, thought to be a grave. This *dogū* (Fig. 3a) was found lying on its side, with only the left arm touching the base of the pit, suggesting that it was buried nestled in the arms of the deceased. The grey-black body was carefully burnished, creating an almost shiny effect. This *dogū* is wearing what appears to be a tight-fitting bodice, with braiding around the hips. Linear incised designs mark out circles, spirals, straight lines and polygons, with some areas highlighted by cord-marking and rows of dots. The figure is wearing a triangular mask, attached to the head using an elaborate fitting that merges into a distinctive coiffure or head covering. Female genitalia and buttocks are clearly depicted as exposed and unclothed (Doi 2009b, 117; Kaner 2009, 39).

Northeast of Tanabatake and Nakappara, a large standing *dogū* was discovered at Nishinomae in the mountains of Yamagata prefecture. The upper part of the *dogū* (Fig. 3c) was carefully smoothed but relatively simply decorated with linear incisions around the neck, breasts and vertically down the abdomen. It is distinct from the other *dogū* now designated as National Treasures in having no facial features represented, nor any depictions of hair. The multiple small holes around the top and rear of the head suggest that it may originally have worn a mask, perhaps made of wood or some other organic material that did not survive. The lower body is decorated with elaborate incised and cord-marked decoration, indicating a pair of trousers with asymmetrical designs around the hips (Nishinomae 2009, 103).

The large hollow figure from Chobonaino (Fig. 3b) in southern Hokkaido dates to the Late Jōmon (c. 3500–3000 years ago). The figure was apparently buried in a stone cist, part of a burial which includes fragments of a lacquer comb associated with a circular setting of stones, and was very well-preserved, missing only its arms. Decoration of the body, including impressed and incised dots, thin bands of clay incised with cord-marks and lines, and areas of geometric cord-patterned designs, indicates a figure wearing a kind of halter top tied at the back of the neck with a knot of clay and full-length trousers. The face, tilted slightly upwards, has impressed dots and lines suggestive of a beard, or possibly tattoos. The surface is further treated by burnishing the clay and the application of black lacquer, for example around the beard. The top of the head is adorned with a carefully sculpted chignon-like feature. At 41.5 cm high, the figure is considered nearly a quarter life-size (Bailey 2009, 60–68).

Contemporary with the Chobonaino figure, a *dogū* with hands clasped together from Kazahari I (Fig. 3d) on the Pacific Coast of Aomori prefecture suggests a somewhat different outfit. This figure is clearly wearing a mask, above which emerges a chignon, or hat-like feature, pierced by a hole. The excavators suggested that this figure may have originally sat on a wall ledge in one of the pit dwellings at Kazahari I. It was found in pieces on the excavated floor of the building, but traces of asphalt suggested it had also been broken and repaired in antiquity. Much of its surface was originally painted in red, known to be a significant colour in Jōmon material culture. The cord-marked designs, broken up with smooth burnished areas on the upper arms, knees and feet, imply woven garments made in pieces, while the pronounced shoulders suggest some kind of padding. The dots running down the middle of the front of the torso are reminiscent of buttons. The distinctive clasped-hand pose is unusual among Jōmon *dogū* figures, and interpretations include a figure in a trance or a posture of childbirth. The double band of clay around the neck with a series of vertical incisions may represent a necklace (Doi 2009c, 91).

The great majority of Jōmon *dogū*, of which over 20 000 fragments have been discovered from across the archipelago, are just that: broken fragments. Many theories have been put forward as to the interpretation of these objects, and the reasons why so many were seemingly deliberately destroyed before entering the ground to form part of the Jōmon archaeological record. A small number of sites have produced large numbers of *dogū* fragments, including Sannai Maruyama in Aomori, Shakado in Yamanashi, and Kashihara in Nara (Kaner 2009). They form part of the Jōmon ceramic tradition, which began with some of the oldest known ceramic containers in the world, found at Ōdai Yamamoto in Aomori prefecture in 1998, carbonised accretions of food residues which are dated to around 16 500 years ago (see Kaner/Taniguchi 2017). Jōmon ceram-

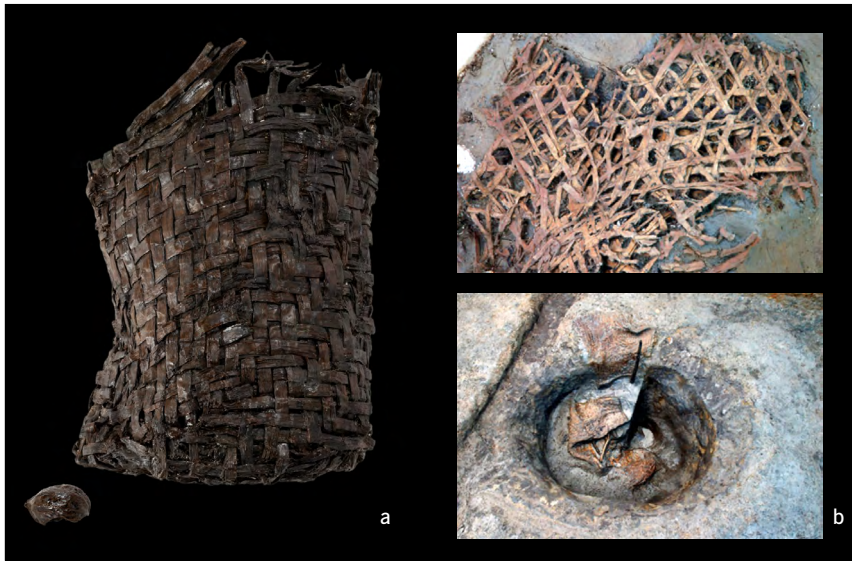



**Fig. 4a–b** Baskets from Sannai Maruyama (a) and Higashimyō (b).

***Abb. 4a–b*** *Körbe aus Sannai Maruyama (a) und Higashimyō (b).*

ics were produced in a great diversity of forms and decorative styles

## Basketry

The weaving of clothes is a technology somewhat related to the use of baskets. A number of exceptionally well-preserved examples of Jōmon basketry have been discovered in recent years. One of the most famous is a basket bag from Sannai Maruyama that contained walnuts, dating to the Early-Middle Jōmon period (5900–4300 years ago) (Okada 2021b, 36–37).

Another is a set of baskets from the site of Higashimyō in Saga prefecture, dating to the Initial Jōmon, around 8000 years ago (Fig. 4). Higashimyō lies at the top end of a large embayment of the Ariake Sea, on the Saga Plain, and is one of the earliest and largest waterlogged shell midden sites in Japan. It revealed over 45 000 pottery sherds, 43 000 stone tools, 120 000 cobbles, 160 stone clusters, 19 stone heaps and eight human burials from a cemetery, including a group of three who seem to have been buried at the same time, in a crouched position. Some 400 baskets were found in pits beneath the shell midden deposits, some of them containing nuts, suggesting that the Jōmon people living here had already understood the processes needed to leach toxic tannins from horse chestnuts and acorns prior to consuming them (Saga-shi 2017). The scale of basketry use at Higashimyō demonstrates that the idea of weaving was already well established at this early stage.

## Intensification of bodily display

The Karinba site in southern Hokkaido offers an exceptional insight into clothing and personal adornment in the later part of the Jōmon period. Karinba is located on low terraces of the Ishikari River, the longest in Hokkaido, on the southern edge of the Ishikari plain. Excavations in 1999 revealed four particularly large burial pits, each containing multiple burials and very large quantities of personal accessories, many of them lacquered. These included hair combs, armlets, large quantities of beads and fragments of clothing, among which, sensationally, the remains of a long red woven sash that is thought to have been worn around the waist of one of the deceased. A total of over 200 000 objects were recorded at the site, which had components dating to many different phases from the Initial Jōmon period, around 8000 years ago, through to the Early Modern Ainu period (from the 13th century AD). Over two-thirds of the finds dated to the later part of the Jōmon period (3500–2000 years ago). Much of the site remained uninvestigated, but from the 900 burial pits that were uncovered, it is estimated that there was a total of around 3000 pits in the burial ground altogether (Uwaya/Kimura 2016).

Returning to the main island of Honshu, an exceptionally well-preserved and partly waterlogged site was investigated in the late 1990s and early 2000s, some five metres beneath the present ground surface of the Niigata Plain on the Sea of Japan coast. Among the remains of a multi-phase fishing community, which included the wooden posts from buildings, riverside features and an abundance of organic remains, many personal accessories and lacquered objects were recovered, allowing the reconstruction of an individual dressed in an elaborately decorated outfit, suggesting that dying and weaving were important activities (Fig. 5). Matsumoto Naoko has written persuasively about the importance of particular colours in the Jōmon period generally, making a compelling argument for the cognitive significance of such colour choices (Matsumoto et al. 2022).

Aota dates to the Final Jōmon period (in this region from 3000 to 2300 years ago), the chronology based on pottery typology supported by dendrochronology from the wooden posts (ORJACH 2025). The site, located on the so-called *fossa magna*, a major tectonic fault line that links Mount Fuji with the Sea of Japan, was preserved as a result of a geological catastrophe that saw the ground surface drop dramatically, leading to inundation. At least two phases of occupation were determined, indicating the resilient nature of the Jōmon community there. The finds at Karinba and Aota demonstrated that by the later Jōmon period (around 3500 years ago), clothing was being used to express increasingly complex ideas about how to dress certain members of society appropriately.

## Jōmon clothing today

The representation of clothes and other items of personal adornment form an important part of reconstructions of life during the Jōmon period. Many of the most influential of these reconstructions have been created by artist and illustrator Aki Sahoko, who works closely with archaeologists to produce images that express the latest thinking in how Jōmon people lived (Fig. 6; Aki/Bausch 2024; Aki/Koyama 2008). Ideas about the Jōmon period have undergone a major reassessment in recent decades. For Edward Morse, the denizens of the Ōmori shell mounds were at the barbaric end of the scale of civilisation, quite likely engaging in cannibalism in between fabricating their ›rude‹ vessels. For a long time, there was little recognition of any role for these aboriginal populations in the formation of modern Japanese identities, with affinities instead being sought with the later, rice-farming and metal-using Yayoi peoples who arrived in the Japanese archipelago during the later 1st millennium BC.

The Jōmon period is currently enjoying a boom in popularity and interest, partly sparked by greater public awareness of some of the remarkable achievements of nameless Jōmon craftspeople through designations such as the National Treasure *dogū*, the inscription of 17 Jōmon sites

**Fig. 5 (right page)** Reconstruction of Jōmon clothes from Aota, Niigata. Final Jōmon (c. 2500 years old).

***Abb. 5 (rechte Seite)*** *Rekonstruktion von Jōmon-Kleidung aus Aota, Niigata. Finale Jōmon-Zeit (ca. 2500 Jahre alt).*

Head of a *dogū* with earrings and a pinned-up hairstyle (Urushiyama site)

Red lacquered earring (Wakeyachi A site)

Shell bracelet (Funadomari site)

Example of the patterns used for the clothing (Makimae site)

Red thread used for the embroidery (Aota site)

Leather shoes

Reconstruction of a Jōmon woman (Illustration by Reiko Ishii)

Lacquered Comb (Korekawa Nakai site)

Shell and jade bead necklace

Jade bead (Shimo-yakebe site)

Red lacquered wooden water jug (Wakeyachi A site)

Model for the 工-shaped pattern of the clothing (Urushiyama site)

Shell bead anklets (Funadomari site)

**Fig. 6a–b** Two different modern artistic reconstructions of Jōmon clothes (Aki Sahoko).

***Abb. 6a–b*** *Zwei verschiedene moderne künstlerische Rekonstruktionen von Jōmon-Kleidung (Aki Sahoko).*

in northern Japan as UNESCO World Heritage[1], the role played by Jōmon archaeology in new tourism narratives relating to initiatives such as Japan Heritage[2], the hard work of archaeologists across Japan in promoting their discoveries in a variety of media, and through exhibitions such as that at the Tokyo National Museum in 2018 (Tokyo National Museum 2018) and Paris in 1998 and 2018 (Maison de la Culture du Japon 1998; Maison de la Culture du Japon 2018). Jōmon people are now regarded as (albeit fictive) ancestors in this nation, where, after all, the veneration of ancestors is hugely important. Reconstructions and interpretations of Jōmon lifestyles seem to offer an alternative way of inhabiting the Japanese archipelago, far removed from the alienation and environmental devastation offered by the hyper-urbanised late-stage capitalism that is the norm for most Japanese people today. This shift of perception about the Jōmon, from primitive aborigines to ecologically wise and resilient ancestral residents of the archipelago, can be seen in the change in the ways that Jōmon artist Aki Sahoko illustrated Jōmon clothes in 1983 and again in 2021 (Fig. 6).

The public appreciation of the sophistication of Jōmon clothing is enhanced by experiences such as that available at the refurbished Tōkamachi City Museum in Niigata prefecture, home of the Middle Jōmon Sasayama site (c. 3500 years ago), where many elaborately ornamented Flame pots are designated as National Treasures (Ishihara 2018). Courtesy of digital technologies, visitors can dress up as Jōmon people onscreen. Many Jōmon-themed museums have sets of Jōmon outfits that visiting school groups and other visitors can try on for size. In these ways, contemporary visitors can experience Jōmon fashions for themselves, wrapping their own bodies to bring them closer to their stone age forbears.

## Acknowledgements

I am grateful to all the Japanese archaeologists and museum curators who have so generously shared their data and ideas with me over many years. Thanks to Okuda Tomoko for preparing Fig. 1. I am also grateful to the organisers of the conference and editors of this volume for allowing me to participate in the conference and subsequent publication.

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6 Aki Sahoko and Asahi Shimbun

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# Bislang erschienene Bände in der Reihe »Tagungen des Landesmuseums für Vorgeschichte Halle«

Die Reihe der Tagungsbände des Landesmuseums wurde 2008 ins Leben gerufen. Anlass dazu war die Konferenz »Luthers Lebenswelten«, die im Jahr 2007 in Halle (Saale) ausgerichtet wurde. Bereits der zweite Tagungsband widmete sich mit dem Thema »Schlachtfeldarchäologie« dem Mitteldeutschen Archäologentag, der seit 2008 jährlich vom Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt veranstaltet und zeitnah publiziert wird. Dem großen Anteil internationaler Autorinnen und Autoren entsprechend, erscheinen viele Beiträge dieser Reihe in englischer Sprache mit deutscher Zusammenfassung.

Mit dem zuletzt erschienenen Tagungsband konnten die Vorträge des Internationalen Workshops »Der soziale Wert prähistorischer Beile – neue archäologische und archäometrische Ansätze« in zahlreichen Artikeln renommierter Forscher verschiedenster Fachdisziplinen vorgelegt werden.

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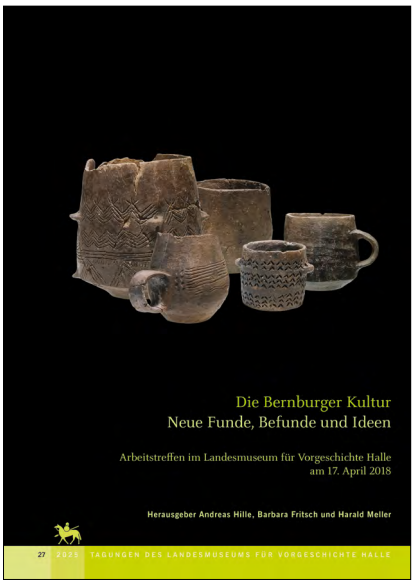
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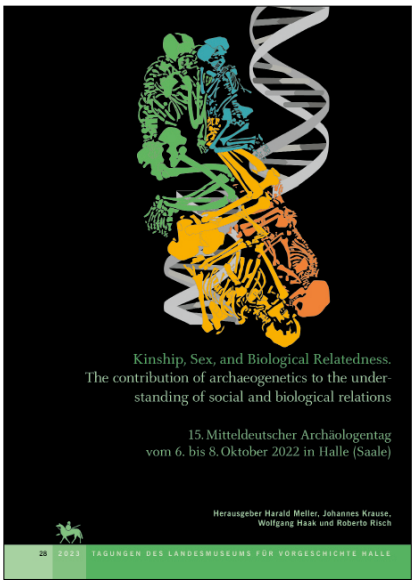
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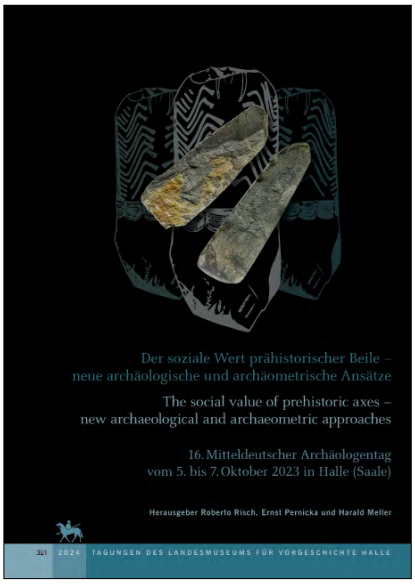
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Erhältlich im Buchhandel oder direkt beim
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Deutschland
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Wie kleideten sich die Menschen in der Steinzeit, welche Materialien und Techniken nutzten sie und wie lassen sich diese nachweisen? Ist der Beginn der Kleidung auf ein aufkommendes Schamgefühl oder auf den praktischen Schutz vor der Witterung zurückzuführen? Eng verbunden mit diesen Fragen ist die Untersuchung von Mensch-Tier-Beziehungen und welchen Einfluss diese bei der Wahl der Rohmaterialien für die Herstellung von Schmuck und Kleidung hatten.

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Landesamt für Denkmalpflege
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ISBN 978-3-948618-99-5
ISSN 1867-4402